Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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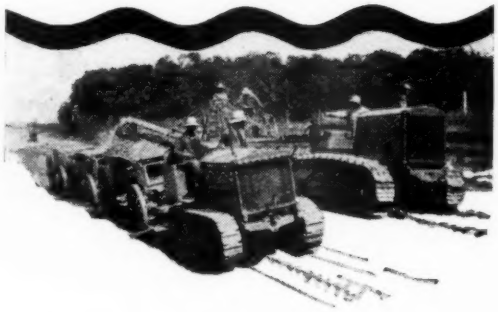

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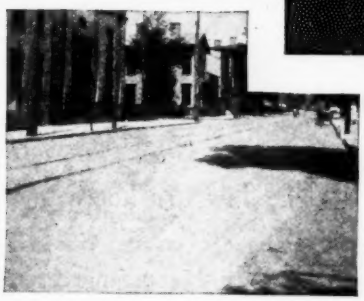

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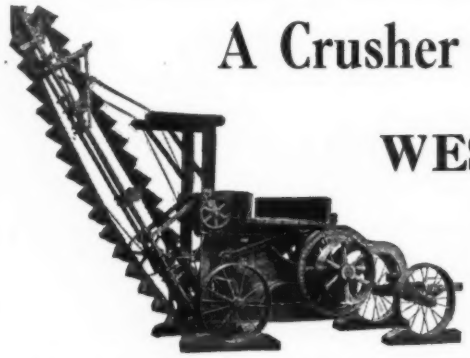

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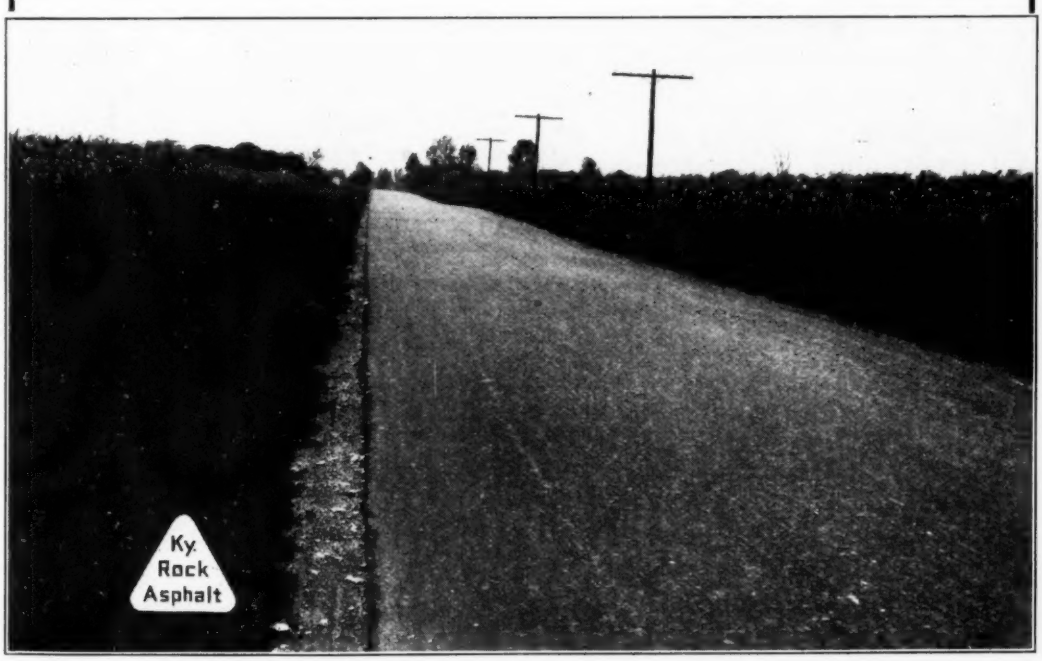

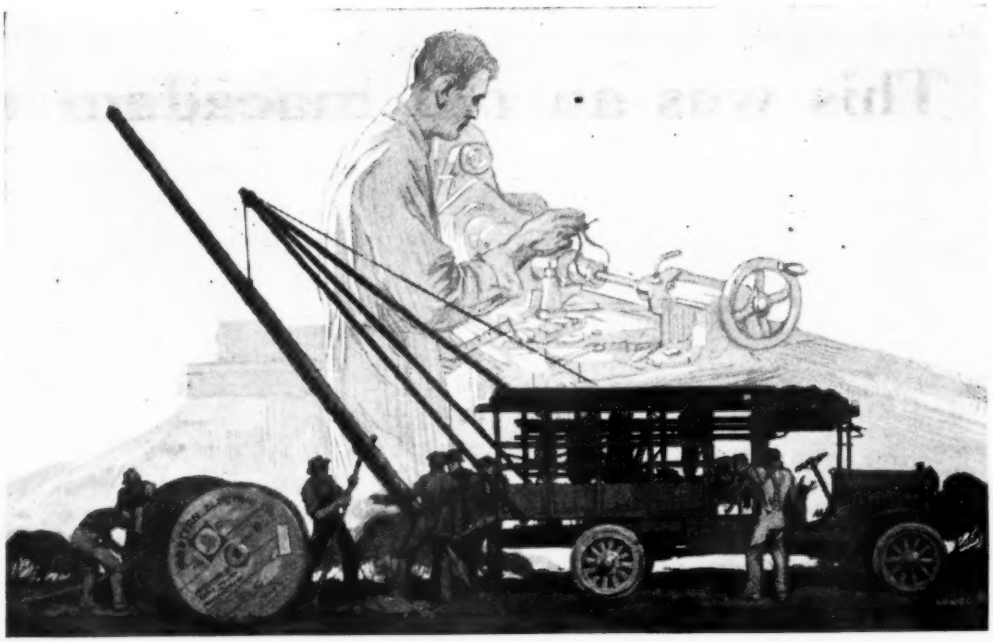

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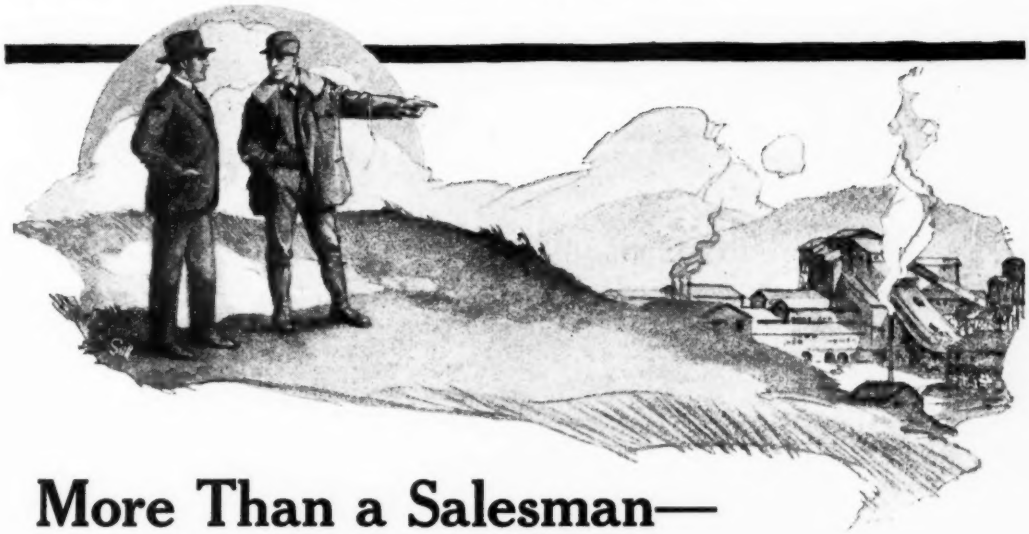

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MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

CHAMPION SNOW PLOW ATTACHED TO A HOLT TRACTOR CLEARING SNOW FROM STREETS OF NEW YORK CITY.

Motor Truck Operation and Accounting—73

IT PAYS TO KEEP THE HIGHWAYS FREE FROM SNOW

By William E. Voorhees, Kennett Square, Pa.

The winter of 1919-20 was one of unprecedented severity. Snow storm followed snow storm with distressing frequency. City street departments and country highway officials were utterly unable to devise plans for keeping the traveled thoroughfares free from snow. The following winter, that of 1920-21, was quite mild. There was but one snow storm of any size and that came along late in the winter. In January, 1921, it was possible to travel from Boston, Mass., to Bangor, Maine, without seeing a speck of snow—something unparalleled in the history of that section.

We Are Due for a Snowy Winter

No one can tell whether we will have light or heavy falls of snow during the coming winter. The law of averages would indicate that there will be plenty of snow. But whether the snow comes or does not come it will certainly be the part of wisdom to prepare for it. No sane person permits his insurance to lapse simply because there has been a scarcity of fires. In like manner sensible city and country highway officials will endeavor to be prepared for the snow if it does come, and, should the winter prove to be mild, they will have the satisfaction of knowing that they were in a position to cope with the snow storms had they appeared.

A Foot of Snow More Expensive, If Left on Street, Than a Great Fire

Few people realize the colossal losses that annually occur in this country through the interruption of traffic by reason of snow storms. A foot of snow on a city street is a greater menace, if permitted to lay for any length of time, than a disastrous fire. The City of New York was unable to cope with the heavy snow storms that prevailed during the month of February, 1920. The sum of $5,500,000 was expended for hand labor snow removal alone, and the results were far from being satisfactory. The Merchants' Association estimated that the actual money loss to the city in the twelve days that it was in the grip of the storm amounted to $60,000,000, or $1,000 per day for every man, woman and child in the municipality. This, be it remembered, was in one city alone. Add to this amount the loss sustained in all of the large cities, as well as in the rural districts, in the section of this country north of Washington, D. C., and east of the Rocky Mountains, and the result is a staggering total.

Counties Have Their Snow Removal Problems

Losses due to the interruption of traffic by snow storms are not by any means confined to the large cities. In a Philadelphia morning paper of February 21, 1921, the following headlines appeared: "Eighteen inches of snow in Dauphin County." "Lancaster County is covered beneath eleven inches of snow." Reference is made to these two counties merely to show the conditions that prevailed in every county all over the northern part of the country at that time.

CHAMPION SNOW PLOW ATTACHED TO A G M C TRUCK CLEARING SNOW FROM BROAD STREET, KENNETT SQUARE, PA.

The farmers of Dauphin County sell their produce in the city of Harrisburg and buy their supplies in the same city. The farmers of Lancaster County do their trading in the city of Lancaster. The country roads in both counties were blocked with snow for several days after the storm of February 20, 1921. Farmers could not deliver goods to the cities, except in limited quantities and at large expense. The merchants of the cities could not do business with the people in the country. Had it been possible to remove the snow promptly from all of the main roads of the two counties thou-

Speaking of the Efficiency of Motorized Equipment

—this Mack tractor was purchased by the City of Akron to haul trailers carrying garbage to the Municipal Hog Feeding Grounds.

The tractor was bought with the specific understanding that it would haul three fully loaded trailers. In actual operation, however, it has been hauling six constantly and without any difficulty.

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Capacities—1½ to 7½ tons. Tractors to 15 tons.

"PERFORMANCE COUNTS"

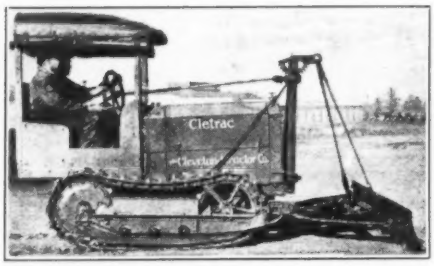
sands of dollars and no end of discomfort would have been saved.

Cost of Snow Removal No Longer Great

Until quite recently the idea was quite generally prevalent among city and country highway officials that, while snow storms undoubtedly caused large losses through the interruption of traffic, yet there was no remedy in sight, as the cost of freeing highways from snow was practically prohibitive. In the old days when snow could only be removed by the hand labor and shovel method this was measurably true. Today it is no longer true. It still costs money to remove snow; but it costs far more not to remove it.

New York City Learned from Costly Experience That it Pays to Remove Snow by Modern Methods

Reference has been made to the fact that the City of New York spent over $5,000,000 for snow removal in February, 1920. One year later the streets of the city were practically cleared of snow over



CLETRAC "TANK TYPE" TRACTOR AND CHAMPION SNOW PLOW. NEW YORK CITY PURCHASED 100 OF THESE OUTFITS FOR SNOW REMOVAL WORK.

night at a very insignificant cost. The difference is seen in the fact that in 1920 the hand labor and shovel method were very largely used, while in 1921 the city employed a large number of motor trucks and tractors equipped with Champion Snow Plows in moving snow from the middle to the sides of the streets.

Removing Snow on Connecticut Highways

The Connecticut Highway Department reports that during the heavy snow fall, winter of 1917, the cost of snow removal on a total of 970 miles was $40,000, or a trifle more than $40 per mile. It is true that the State of Connecticut used advanced methods of snow removal, but these methods are by no means a secret and are available to every Highway Department in the country. The method employed by this state was simply to utilize a considerable number of motor trucks and equip them with push plows of the Champion type. Just as soon as the snow began to fall these plow-equipped trucks were sent out over the main highways and were kept working, pushing the snow to each side of the roadway, until the snow ceased falling and the highways were cleared for traffic. The advantages of this method of snow removal are readily apparent. Motor trucks move rapidly, to and from the job, and on it. They are never in the way of traffic, because they move fast enough to keep away from it. They have sufficient power to push a full blade load of loose snow, even when running at a fair rate of speed.

The Modern Method

This is the modern and the only practical method of economical snow removal. It means that states, counties and cities must spend money in the purchase and hire of trucks and tractors, as well as in the purchase of snow plows. On the other hand, it means that the main travelled thoroughfares can be kept open for traffic, at reasonable cost, in the winter as well as at other seasons of the year.

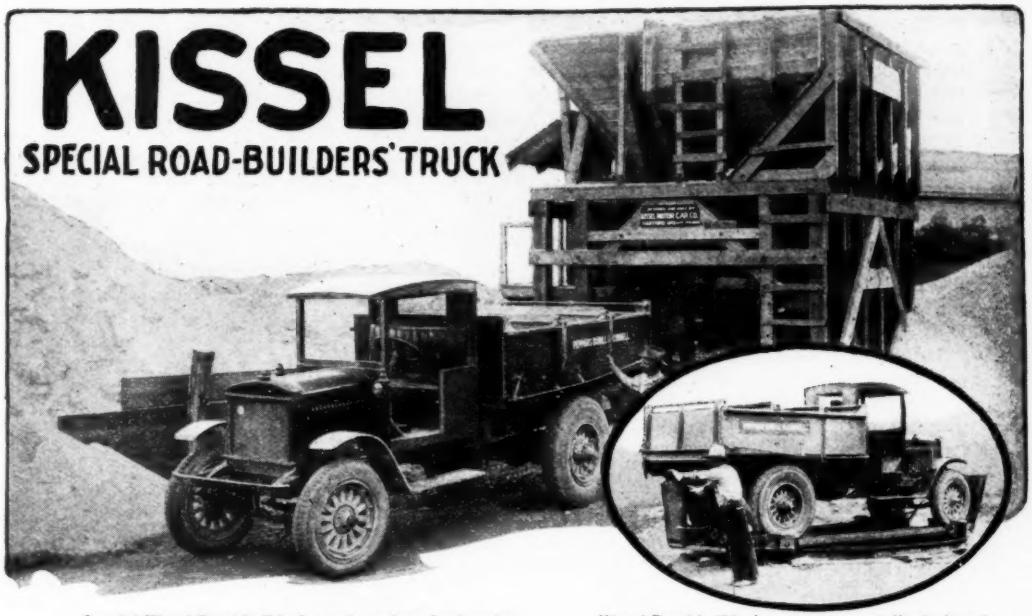
Now is the Time to Prepare

It is the method employed in Massachusetts, Connecticut, New Jersey, Pennsylvania, and, to some extent, in other states. There is hardly a state where snow falls are to be expected, however, that has anywhere near the equipment it should have for snow removal. Measures should be taken immediately by these states, as well as by the counties, and, wherever possible by the towns, to secure trucks and plows in quantities so that when the snow falls it can be pushed out of the main travelled thoroughfares promptly to the end that the annoyance and losses of the past may be eliminated.

Utilizing Motor Fire Apparatus in Snow Removal

In these days practically all towns, villages and boroughs of any size own motor fire apparatus. When the highways are filled with snow this apparatus is of little value, as it is impossible to move it to the scene of a fire. Such apparatus can very readily be equipped with push plows, thus making the machine of value not only for its primary purpose of extinguishing fires but also to keep the streets open for regular traffic.

This is an age of gasoline power. Large numbers of trucks are being used in every section of the country to transport mail, freight and supplies. Many of these trucks have regular runs between important cities. It has been



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Kissel Road-builder's truck on specially designed turntable, turning loaded truck around in less than ten seconds—saving time, labor and depreciation on truck.

Kissel Engineering Service Helped Establish this Road-building Efficiency Record

The real saving to Peppard, Burrill & Connell, prominent Minneapolis contractors, by using efficiency methods was in actually finishing this 4.7 miles *in less than two months,* while most contractors would have taken three months or more.

JOHNSON CREEK FOOTAGE TABLE

Work Started . . . . July 6, 1921.
Finished . . . . September 6, 1921.

Total actual number of working days, 40
(No deductions for any delays except rain.)

FOOTAGE TABLE

Daily Average Footage . 736 feet
Highest Daily Footage . 903 feet—Aug. 24.

Aug. 1—rain	Aug. 14—Sunday	Aug. 28—Sunday
2—rain	15—827 ft.	29—855 ft.
3—570 ft.	16—498 ft.*	30—318 ft.†
4—742 ft.	17—rain	31—rain
5—711 ft.	18—352 ft.‡	Sept. 1—wet road
6—723 ft.	19—615 ft.	2—520 ft.
7—Sunday	20—rain	3—645 ft.
8—845 ft.	21—Sunday	4—Sunday
9—813 ft.	22—681 ft,	5—Lab'r Dy.
10—rain	23—711 ft.	6—520 ft.
11—wet road	24—903 ft.	(End—6 hrs.
12—620 ft.	25—794 ft.	work.)
13—618 ft.	26—700 ft.	*Rain, 6 hrs. work.
	27—866 ft.	†‡Rain, 4 hrs. work.

Total Footage, **15,447** Total Working Days, **21**

(Note—August 16th and 18th counted as one day: also August 30th and September 6th, as delay on these days due to rain.)

Johnson Creek Road Computations

THE ENTIRE JOB

Average Daily Footage, 620.4 feet.

Length of Road, 4.7 miles, or 24,816 feet. Total number of days on which any work whatsoever was done, 40.

ONE WEEK'S WORK

Daily Average Footage, 766 feet.

In completing this job of 4.7 miles of concrete road there was only one week in which the work was not delayed by rains and wet roads—the week of August 21 to 27. The footage this week, by days, was—

Monday	681 feet	Thursday	794 feet
Tuesday	711 feet	Friday	700 feet
Wednesday	903 feet	Saturday	866 feet

Total Footage for the week, 4,655 feet
Number of days worked, 6

Progress from August 1st to End of Job
Average Daily Footage, 736 feet.

During period from August 1st to September 6th, when the job was completed, rain and wet roads prevented any work on eight working days. On two days, namely, August 16th and 18th, only one-half day's work was possible, due to rain. Despite this handicap, the total footage for this period was 15,447. The number of days worked was 21.

Send for special illustrated folder showing, step by step, how the Johnson Creek Road contract was Kissel Engineered and systematized. Address

KISSEL MOTOR CAR CO., Hartford, Wis., U.S.A.

estimated that during the year 1920 at least 15% of the freight transported in this country was handled by motor trucks. This does not take into account the large amount of produce hauled from farms to local markets. There is nothing that paralyzes truck traffic like a snow storm. If the country is to have the full benefit of this new and valuable method of transportation, effective measures must be taken to keep the main traveled highways open for travel in winter as well as at other seasons of the year.

Much has been spoken and written during recent years regarding the evil results that inevitably follow a policy of unpreparedness. With the experience of the Great War just behind them the American people should realize that it is at all times immensely profitable to spend reasonable sums for equipment when such expenditure will assuredly be saved many times over when the snows of winter descend upon us.

TRUCKS PROVE THEIR WORTH ON COUNTY ROAD BUILDING

By William Tonkel, Road Superintendent of Allen County, Court House, Ft. Wayne, Ind.

(Editor's Note:—The following article is based on the experience of Allen County, Ind., in the operation of a fleet of 3½-ton Acme trucks on county road work. This county has saved $28.80 per day by using trucks.)

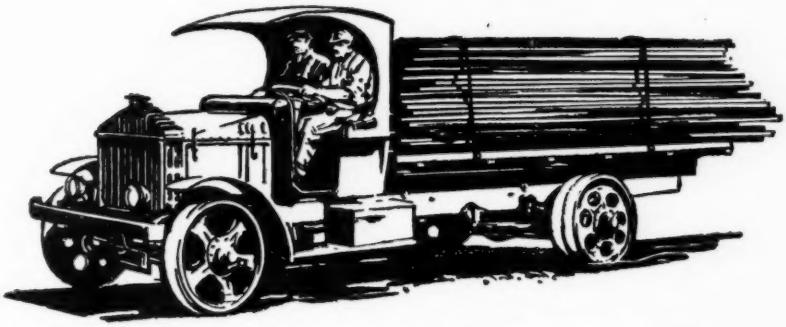
Our original Acme truck is approximately 3 years old, and the other two are nearly as old. All three are 3½-tonners. Besides our Acmes we are working 4 trucks of other makes ranging from ¾ to 3½ tons. In a recent gasoline consuming test the Acmes got 80 miles on 17 gals., while other 3½-tonners needed 21½ gals.

The thing that first made me believe that the Acme was the truck for our work happened some four years ago. There were 8 trucks of several different makes building a road at the end of a 7-mile haul, and each truck was handling 3 yds. of gravel to a load. The road was slightly hilly, and in some parts not very good. The Acme was the only truck that could take its load over certain places without shifting gears, and the one truck that performed its work in good shape. This performance, I have since learned, is not unusual with Acme trucks.

Allen County uses its trucks entirely for maintenance and repair work. When new roads are to be constructed, the work is let out under contract. For this maintenance and repair work we decided that a 3½-ton truck would be best, for a 5-ton truck is too heavy. Our trucks have a 3½-yd. body, which is always heaped up, so we carry approximately 4 yds. of stone, weighing approximately 5 tons. This is something of an overload, but our trucks stand up very well under it. The northern part of Allen County is rather hilly; the rest is fairly flat. Our roads are made of crushed stone, macadam and gravel.

At present we are repairing a piece of road 10 miles from Ft. Wayne, making a 20-mile round trip. The material is crushed stone, which is delivered at Ft. Wayne in freight cars. The truck is loaded by hand or by a chute, and run out to the point where the road is being repaired. The driver opens the rear gate 3 or 4 ins., by loosening a chain. Then

ONE IN A FLEET OF THREE ACME 3½-TON TRUCKS AS OPERATED BY ALLEN COUNTY, IND., ON ROAD WORK.



10 years of service

Pierce-Arrow has ten years' experience with over 20,000 trucks in actual road service. The service organization has watched minutely these trucks perform. This knowledge was used in designing the present line of trucks so that

They last and keep running at a minimum cost and upkeep expense. They do more work, make more trips and make each trip in minimum time.

They carry maximum effective loads and are always ready for service. They can be easily run with the least wear and strain.

Pierce Arrow

Delivers more work
Loses less time
Lasts longer and
Depreciates less
Costs less to operate

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

he gets into his cab, raises the dump body and starts the truck, so that a stream of crushed stone flows out of the rear end of the body and is distributed evenly along the road. After discharging his load he returns to town for another.

It is very easy to make 4 such trips in a day, and if forced a little we could make 5. However, making 4 a day, we can haul 16 yds. of stone per truck to the point. The cost per day on this haul is $19.26, or $1.20 per yard and $1.24 cts. per yard mile. If a team were to do this work it could make only one trip a day hauling 2 yds. of material. A team costs $6 a day, so it would cost us $3 per yard to haul stone to this point, against a cost of $1.20 by truck. Besides, a team could not spread the stone as the truck does.

Suppose that, instead of repairing this road, we were building it. It takes 1,166 yds. of gravel to build a mile of road. Hauling by team and handling 2 yds. of gravel per day, it would take us 583 days to perform the work. A truck handling 4 yds. of gravel to the load, or 16 yds. a day, could do it in 67 days. At the very low cost of $6 a day for a team, it would cost us $2,208 to haul the material; hauling by truck, at a cost of $19.26 a day, it would cost us $1,290.37, giving us a saving of $917.63.

Building a mile of road that distance from town would cost us by truck $1.11 per yard, and by team $1.89 per yard, a saving of 78.7 cts. per yard, or 41.6% in favor of the truck. But even though the truck did cost more, it would still pay a road superintendent to use a truck because of the greater amount of material that he could handle in a given time. As in all outside work, it is necessary to make the most of good weather.

The trucks employed in this service make a very high mileage, averaging from 75 to 90 miles a day. The average for an Acme truck last year was approximately 74.5 miles. The very low fixed expense of 93.3 cts. a day is due to the fact that these trucks have no taxes, license or administrative overhead, and only a low garage and insurance charge. Last winter was very open and we were able to work 285 out of 305 working days. The average cost for the time worked was $18.37 per day. All our repair charges are lumped, but the $600 per year allowed is ample.

Our trucks are run at an average speed of 14 to 15 miles per hour, and the Acmes are the only trucks we have that can travel 18 miles an hour without injuring themselves.

A summary of the cost data follows:

COST DATA ON OPERATION OF 3½-TON ACME TRUCK, AS OPERATED BY ROAD SUPERINTENDENT, ALLEN COUNTY, FT. WAYNE, IND.

AVERAGE COST

Cost per day (including driver)	$ 18.3671
Cost per mile	.2465
Total cost for period (one year)	$5,235.28

OPERATION

Days operated	285.
Miles traveled	21,235
Miles per day	74.5
Miles per gallon of gas	4.7
Miles per gallon of oil	160.

ITEMIZED COST

Driver cost per day (included above)	$ 5.35
Depreciation per mile	$ .0428
Maintenance & repair, estimated, per mile	$ .0283
Tire cost, actual, per mile	$ .0335

INDIANAPOLIS BUSINESS MEN RESIST ADVERSE TRUCK LEGISLATION

The city of Indianapolis, by ordinance passed in the city council in 1919, declares that as the city streets are maintained from city funds, motor trucks shall be taxed $4 per ton truck capacity by the city for street maintenance.

The state requires by an act passed in the 1921 session of the legislature that motor trucks shall be taxed at about $15 per ton truck capacity for highway maintenance, and the attorney general of the state declares that the city streets of Indianapolis are a part of the state highways.

But as 85 per cent of all trucks owned and operated in Indianapolis do not use the state highways they should not be required to pay a direct tax for their maintenance, in the opinion of their owners, as agricultural implements are not required to pay a direct tax for the maintenance of the streets of Indianapolis.

The 85 per cent of all trucks owned and operated only on the streets of Indianapolis are required by law to pay to the state for the upkeep of the highways which they do not use and they are required by ordinance to pay again to the city of Indianapolis for the same purpose.

It has been learned that 10 or 15 Indianapolis firms would be required under the present law to pay from $500 to $1,000 in direct taxation for highway maintenance while they have no occasion for using the highways, and that over $100,000 is taxed annually against Indianapolis business men for state highway maintenance, who use only Indianapolis streets and pay a street maintenance tax.

Farmers who use the state highways and the Indianapolis public streets with horse-drawn vehicles do not pay a penny of direct taxation for the maintenance of either state highways or city streets.

Heavy tractors and other wheel cleeted agricultural implements, very destructive to highways, are also operated over state highways by farmers without the payment of one penny as a direct maintenance tax.

In view of the foregoing circumstances truck owners in Indianapolis, in conferences called to consider these matters, decided to employ legal counsel to prepare a defense and to resist this legislation, which they regard as unfair and discriminatory. Appeal bonds were held in readiness to take care of all arrests. Motor truck owners have taxed themselves $7 per ton of truck capacity, with a minimum of $1 for the purpose of meeting the contest.

Among the trade associations represented were: Coal Dealers, Sand and Gravel, Retail Grocers, Auto Trade, Transfer, Master Plumbers, Indiana Automotive, Wholesale Grocers, Indiana Transfer and Warehousemen's Association, Association of Electrical Contractors, Commercial Warehousemen, Bakers, Portland Cement, Indiana Highway Transport and Terminal Association, Ice Dealers and Merchants' Association.

The validity of the law, to which the truck owners object, will be determined by the courts. Meanwhile further arrests are enjoined.

PAVING STREET CAR TRACKS IN CALIFORNIA

To the Editor:

I note on page 15 of the August, 1921, issue of Municipal and County Engineering, an article relative to the paving over street railway tracks in California cities, which is rather misleading. The law enacted by the recent Legislature only provided for the paving over street car tracks by the municipalities when a municipality so desired.

It does not relieve the street car companies of their responsibilities unless the city officials determine that public necessity requires the municipality or property to assume this burden.

Yours very truly,

GEORGE MATTIS,
City Engineer.

Aug. 23, 1921. Oakland, Calif.

USE OF TRUCKS AND TRACTORS ON MISSOURI ROAD WORK

Perhaps one of the greatest incentives to road building in Missouri has been the trucks and tractors furnished by the Federal government, says the "Missouri Road Bulletin," the official publication of the State Highway Department.

There are at the present time 650 trucks and tractors furnished in that way working on the roads of the state. Their value, estimating the trucks at $2,000, which is conservative, and the tractors at $4,000 each, means a total valuation of almost $2,000,000. Every one of these 650 machines is constructing roads, either under local supervision or on some state and Federal aid project.

It is hard to estimate the work toward lifting the state out of the mud that these machines are doing, but it is no doubt the greatest single method that is being concentrated on that work so far as its value in dollars is concerned.

Trucks are every day hauling drags, depositing gravel and other building material along the highways in the 114 counties of the state. They have been at the work in some counties for months and a careful engineer would no doubt say they have already contributed their value to the roads of the state.

The trucks and tractors come from the War Department and are furnished through the U. S. Department of Agriculture to the states in proportion to their road activity. It is estimated that Missouri is getting a thirtieth of the entire supply of surplus road building equipment. It is still coming and is being sent out through the State Highway Department as fast as it is received.

The equipment is put out to the counties at minimum cost to cover freight expense from Washington to Missouri and delivery to the county of each piece of automotive equipment in good condition for immediate use. After being received at the State Highway garage in Jefferson City it is carefully overhauled and such repairs as are needed are given each machine. A large amount of repairs are kept on hand for most of the cars in use and these are supplied to the counties at cost.

As a result of this nearly all of these trucks and tractors are today performing a full day's service for bettering road conditions.

Keep Your Roads Open This Winter

Snowed-in streets and roads are a thing of the past now. And every town, township and county realizes that such conditions bring loss and danger to the people of the community.

Keeping your roads open all the time is simple and easy with the **Phoenix Snow Plow.** Present users of the **Phoenix** pronounce it an indispensable piece of road equipment. Wherever it has been employed the labor and expense of keeping roads open has been reduced to the minimum. But its important value is that roads are always open and usable when they are needed.

Phoenix Snow Plow

For Town and Country Roads

Operated by horses, truck or tractor with the power used to push or pull the plow, the **Phoenix** gives you an economical and efficient plow that clears your roads quickly and easily. Strong, powerful construction; built of selected hardwood reinforced by heavy forging and castings, the **Phoenix** Plow will outwear any plow manufactured. Plows to any depth desired and will handle any clearing work of from 6 to 18 feet. Adjustable wings and center plow make the **Phoenix** suitable for both wide and narrow streets, roads and highways.

Write us today for additional information, prices, etc.

PHOENIX MANUFACTURING COMPANY

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EDITORIALS

BUILD TO PREVENT FIRE

We Americans are tolerating an annual fire loss of over $300,000,000 in physical property alone. Each year over 60,000 people are injured and over 18,000 lives are lost by fire. What a sensation it would create if all these injuries and deaths occurred in one great fire, or even in a dozen great fires. But they occur, usually, a few at a time, but time after time, so the result in the end is the same. The bare figures should be impressive enough to the dullest, without considering the sensational aspects of the case. Each injury, or each death, has a personal significance to some individual or family which dwarfs the economic loss, great as that is. But the economic loss represented by these injuries and deaths is at least as great as that due to the destruction of property.

These losses fix fire insurance rates and in paying our insurance premiums we all pay tribute to uncontrolled fire. Those who do not have fires must still help to pay for the fires of others, while those who have fires do well indeed if they are able to make good their losses by insurance. Of course there can be no adequate compensation to the man who suffers the experience of a fire in his home or place of business. Even if he is compensated for the property loss he never can be compensated for the trouble and anxiety experienced.

The enormity of the figures given may be sensed when one reflects that the great public debt could be paid off in a few years if we could apply to it each year the money we are now burning up. Think how this would simplify the problem of taxation which is now so difficult for us all!

Viewed from any angle the fire loss is a total loss and is as ruinous as it is inexcusable. Everything that can be done to lessen this loss must be done. We must have the best of fire-fighting facilities and we must also fight fire when we build—as well as afterwards. Here, as always, prevention is much better and cheaper than cure.

So far as possible we must build structures of the type which are either fireproof or of the highest type of fire resisting construction, and this applies to both public and private buildings, whether in city or country.

The week commencing October 9 is to be observed throughout the country as Fire Prevention Week. This is very good, as far as it goes, as it will serve to direct public attention to what preventable fires are now costing. But we should have 52 fire prevention weeks each year.

Engineers, architects and contractors know how to build structures that will not burn. Since their professional knowledge enables them to build against fire is it not their duty to act in the public interest and to recommend and insist on fireproof construction whenever and wherever possible? We believe it is.

Finally, our fire loss has reached the proportions of a national scandal and disgrace. Instead of feeling sorry for ourselves about it we should be ashamed of it.

BUILDING OR BREADLINES?

A certain amount of amiable optimism makes life pleasant at times, but it does not, of itself, sustain life. Just now a little wholesome and frank pessimism is in order. Two hard facts are staring us in the face: the unemployed now number fully 6,000,000 men and winter is coming on.

It is all very commendable and very agreeable, up to a certain point (and also very easy) to rely on a favorable turn which will ease the hard circumstances of creature existence, but times come when it is well to realize that few good things just happen or are vouchsafed to humanity by a beneficent providence. The thoughtful are in agreement, now, that work must be found for the idle or we are in for a winter of deprivation and suffering.

Fortunately, by taking thought and acting promptly, work can be provided for those now idle and the many others who may be released from industry with the coming on of the cold season. Public works offer the way out.

As everybody knows, many construction projects have been postponed from year to year for just seven years. Much public improvement work, long held up, should now move rapidly forward. A very great deal of this work can be done during the winter season. The directing

minds in the construction industry long ago learned how to cope successfully with cold weather.

This is not only a way out of a bad situation but in the opinion of many it is the only way out. The choice rests between action or inaction, between building or breadlines, between public works or public charity. Only a flabby and unjustifiable optimism will prevent public officials making the proper choice. Now is the time for some robust and rational realism; if we don't take control of the situation in the only way available the coming winter will be one of suffering for the millions of unemployed and their dependents, the women and the children, the aged and the infirm.

While it is unpleasant to direct thought to what will surely happen if we go on waiting for providential, or congressional, relief, it is pleasant indeed to point out that if public works projects be driven forward, now, useful work will be provided for those released from industry and great sums of money will be placed in general circulation, to the immediate and substantial benefit of all lines of business.

EFFECT OF DIAGONAL PARKING ON STREET PAVEMENTS

The effect of diagonal parking on pavements is very bad in some cases. The tendency of such parking is to restrict the traffic to very narrow lanes, and this naturally causes the pavement to wear unequally throughout its width; near the curb it may be as good as new, while near the center of the street it may be badly worn.

The extreme case is reached where diagonal parking is required on car track streets. Nowadays the paving on car tracks is not especially inviting, in many cases, to say nothing of the difficulty and danger of driving on car tracks or of the destructive effect of rails on rubber tires. The tendency is, therefore, for the motorist to keep off the track and, as he cannot drive near the curb because of the parked cars extending far out into the street, he is virtually compelled to drive between the car track and the row of parked automobiles. Frequently this restricts the range available for anything like satisfactory wheeling to a few inches, for each set of wheels, and rutting or other rapid deterioration of the pavement rapidly ensues.

Diagonal parking has its advantages, of course, as it increases the number of machines that can be parked in a block, and it also aids in putting a parked car quickly in motion at the will of its driver without reference to the position or movement of adjacent machines. But whatever the advantages of this type of parking to motorists its destructive effect on pavements is so great and so rapid under certain circumstances that it should not be tolerated, much less required by ordinance.

THE ENGINEER AND TAXATION

There has been more intelligent discussion of taxation during the present year than in an ordinary decade. The reasons for this are well understood. We hope engineers are following the discussion closely and are taking part in it, for the engineer has qualities of mind which should enable him to exert a powerful influence on tax legislation, in the public interest.

We often wonder what engineers think of the various methods of raising revenue by taxation, past, present and proposed. We surmise that the engineer of mature years is inclined to the belief that the whole subject of taxation has been rather badly handled from earliest times down to this hour, with, perhaps, indications of rationality appearing now and then in very recent years.

The engineer is a man of forthrightness who thinks in straight lines and he probably finds abhorrent the devious methods commonly employed in beating the tax devil around the bush. Probably he favors an income tax and some sort of sales, or turnover, tax for if taxes must be levied on a man why not catch him coming and going, earning and spending, to make sure that no one escapes his just burden of taxation?

Not long ago Mr. Lloyd George spoke of "finding money." He was referring to the problem of raising enough revenue to meet expenditures. In other words, the problem is usually to find something that can and will stand a heavy tax, as the politician sees it. The big tax bills usually land where wealth and good nature dwell together.

We urge engineers to turn their attention to the making of equitable tax laws as a high public service. They will find their mental powers equal to the task, we are confident.

RAPID RECONSTRUCTION OF THE BURNED SAUGUS RIVER BRIDGE BETWEEN LYNN AND REVERE, MASS.

Co-operation, plus electricity, recently accomplished an engineering feat of the first order when a 400 ft. section of the burned trestle bridge across the Saugus River connecting Lynn and Revere, Mass., was rebuilt in the record time of 10 days.

Henry S. Baldwin, department engineer of the Lynn plant of the General Electric Company, is credited, both with the inception of the plan and its subsequent execution, although due recognition is accorded both to the support furnished by R. H. Rice, plant manager, and capable technical assistance rendered by other engineers.

SOME OF THE EQUIPMENT WHICH MADE POSSIBLE THE VERY RAPID RECONSTRUCTION OF THE SAUGUS RIVER TRESTLE BETWEEN LYNN AND REVERE, MASS.

Shows Motor-Driven Saw for Cutting Flooring. Floodlights Made Night Work Feasible. Telephones Installed at Each End of the Work. Motor-Driven Augurs, Motor Trucks and Cars, With the Usual Derricks and Pile Drivers Made Up the Modern Equipment Employed for Speeding Up the Work.

The undertaking is probably one of the most unique of its kind and shows how cities, officials and industrial works pooled interests, cut red tape and met a real emergency.

Fire on June 17

The train of events leading up to it started with a fire on June 17th, partly destroying the original structure across the Saugus River, known as the Point of Pines bridge. That fire broke a vital traffic artery.

On the following day the Metropolitan District Commission announced that a new bridge would cost between $60,000 and $150,000, and no funds were available. But in view of the fact that a $50,000 state emergency fund existed the Commission's engineers started specifications anyway. On the 21st Lynn, Revere and the town of Swampscott asked the Commission for a temporary bridge.

A hearing was announced on the 23rd and held on the 30th. In the interim the Commission's engineer had reported that to build a bridge costing $150,000 would mean shutting off travel for six months.

This suggestion of delay, with the summer heavy automobile travel just starting, worried Lynn and Revere not a little.

G. E. Company Offers to Do Work at Cost in 15 Days

On the 29th, the day before the Commission's hearing, the General Electric Company, whose River Works are near the Lynn end of the bridge, offered to rebuild the bridge in temporary form at cost within 15 days. Engineers scoffed but Mr. Baldwin, who took charge of the entire job, was sure it could be done. That afternoon he and John Trudinger, an assistant, went out in a rowboat and inspected the ruins. That night complete tentative plans and cost estimates were made.

The next day after the hearing the Commission decided to let the General Electric Company go ahead. The city of Lynn appropriated $40,000 to finance the work and Governor Cox gave assurance that the state would reimburse the city next winter, when the Legislature meets.

Plans Drawn July 2

Detail plans were drawn July 2, the engineers finishing them in the small hours of the next morning, so that they

could be given to contractors for bids.

The W. S. Rendle Company of East Boston took the labor contract at $14,200 and the General Electric Company agreed to furnish the materials and supervision for $20,000.

On the morning of July 4 steam derricks appeared at the bridge and work started tearing off the damaged deck and weakened piles. Three days later new construction began.

Storms and heart-breaking obstacles interfered from the start. At first it looked like a month's job. Floodlights were put up and the work drove ahead night and day. As days passed the outlook grew brighter.

By July 12 all the caps except on six spliced joints at the Lynn end of the bridge were in position. On the 14th it was possible to cross the bridge on the loose planking while the cross bracing went ahead swiftly.

When the job of laying the wearing surface of 2-in. spruce planks began the workmen were sure that sawing would take ten days to two weeks. The General Electric Company rushed out an individually motor driven circular saw table with mitering arrangements operated by two experts from the Lynn Works. The planks were cut at the proper angle as fast as they could be fed. The laying of the planks was so swift that Mayor Creamer of Lynn was able to drive the last spike—without missing a stroke—on the 18th, and the bridge was done.

Only the best materials have been put into the structure. The new piles are of oak; the stringers, caps, deck, fence, post and hand rails are of long leaf hard pine and the wearing surface of spruce; 270,000 board feet of lumber have been used and thousands of bolts, made upon order at the General Electric plant, thereby saving time and money, will hold the whole together for years to come. The caps are 8x14 ins. and the stringers 10x16, spanning joints. Instead of a temporary bridge, it is made as well if not better than the original structure, and is guaranteed for ten years.

The Governor Congratulates the Engineer

Following completion of the bridge Mr. Rice received this letter from Governor Cox of Massachusetts:

"I desire to add my expression of appreciation to those which have been so properly extended to the General Electric Company for the splendid public service rendered in replacing the Point of Pines Bridge so rapidly.

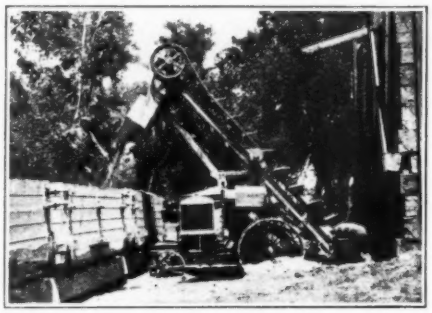
"It was a difficult situation, and the prompt and efficient way in which the General Electric Company met the public needs was most commendable.

"May I in turn, through you, congratulate the engineers and workmen for their fine co-operation which has brought such credit to your organization?"

NEBRASKA USES INDUSTRIAL RAILWAY IN CONSTRUCTION OF GRAVEL ROADS

By George E. Johnson, Secretary, Nebraska State Department of Public Works, State House, Lincoln, Neb.

The Nebraska Federal Aid Project No. 135-A, consisting of the Central City-Chapman road is 9.9 miles long and is located parallel with and adjacent to the Union Pacific Railroad in the east central part of the state known as the Platte River Valley. This piece of road, which is part of the Lincoln Highway, has very flat grades. The grading was done by Merrick County in which the road is located. This work was carried on with tractors and blade graders, followed by teams and fresnoes which were used to correct any slight imperfections that might be left in the profile of the road. The cross-section of the graded road is 24 ft. wide with a 6-in. crown at the center and sloping ditches 2 ft. deep on either side.



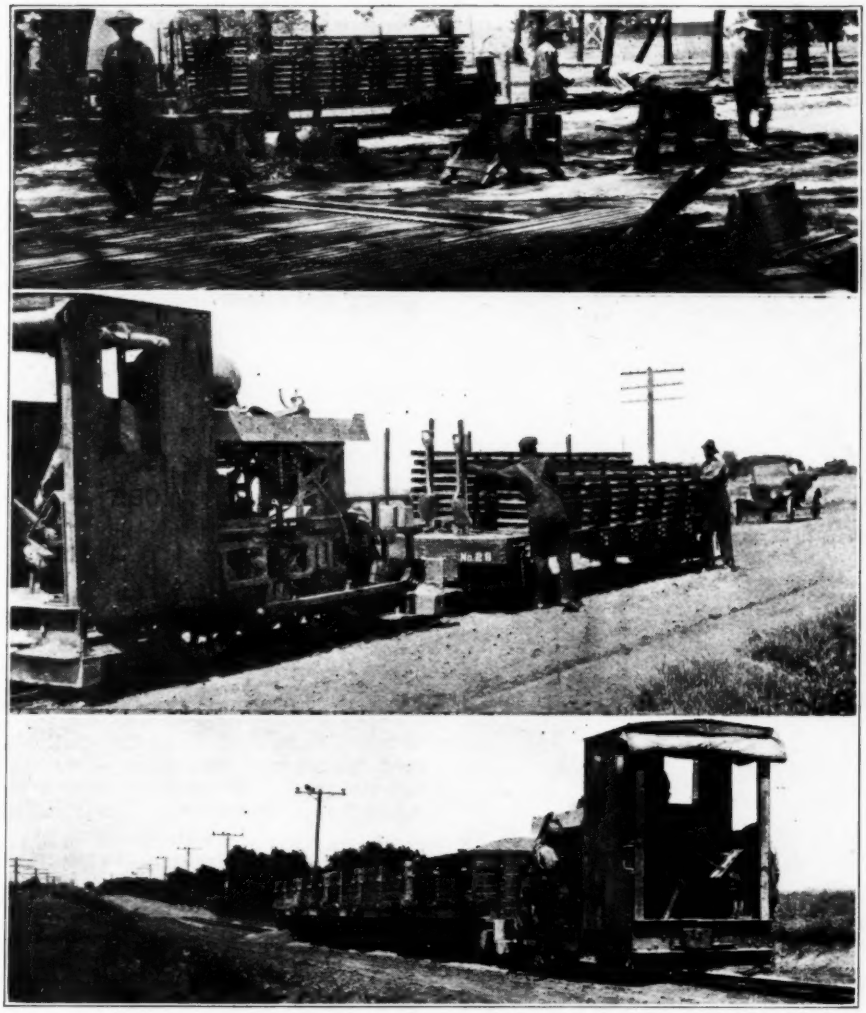
BUCKET LOADER LOADING INDUSTRIAL CARS FROM STORAGE BIN ON GRAVEL ROAD CONSTRUCTION IN NEBRASKA.

The part of the improvement in which Federal and State aid (equally divided) was used, consists of the necessary drainage structures and a gravel wearing surface 18 ft. wide. This wearing surface is composed of 4 ins. of screened gravel with a sufficient amount of clay added to make a firm, compact surface. The soil ranges from a black gumbo, which carries a small amount of gravel, to a rather

loose sand. In some places the soil contains the binder, while in other places clay must be added to hold the gravel together.

The contract for the construction of the drainage structure, which consists of sectional concrete pipes, culverts, headwalls, and one concrete bridge, was let to the Central Bridge and Construction Company. The Nebraska Department of Public Works under the writer as secretary is laying the wearing surface of this project. They are using state owned labor and equipment, most of the latter being allotted to the state as surplus war equipment.

The clay binder used was located at distances not more than 1¼ miles off of the road. The excavating was carried on with an Austin drag line excavator. The short distance hauls were made with a 20-ton Holt Caterpillar tractor and Eagle reversible trailers, while the longer distances were covered with Packard army trucks equipped with hydraulic hoists and end dump bodies. The gravel was obtained from a pit located in an old channel of the Platte River, only 1,500 ft. from



USING INDUSTRIAL RAILWAY ON GRAVEL ROAD CONSTRUCTION IN NEBRASKA. Top: Stock Pile of Rails, Horses on Which Sections of Track Are Assembled, and Car of Assembled Sections Ready to Go Out on Road. Center: Car of Assembled Sections of Track at End of Line Ready to Be Laid. Bottom: Gravel Dumped on Road and Train Used for Hauling It.

the project. The pit was covered with a sandy loam soil which was easily removed with the drag line. The farthest distance the gravel had to be hauled was 6¾ miles.

The gravel is pumped with a 6-in. Centrifugal pump, driven by a 12-in. belt from a 45 h. p. Van Blerk 4-cylinder gasoline motor. The plant is mounted on a raft made up of 5 vertical side pontoons held close together by timbers clamped across the pontoon ends at both the top and bottom. The gravel then runs across a nest of slotted sheet screens assembled with a ¼-in. screen on top, a 1/6-in. screen in the center, and a ⅛-in. screen on the bottom. The screens are mounted above a storage bin of 125 cu. yds. capacity in such a manner that practically all the water is carried off over the side of the bin and returns to the pit. It has been necessary to pump from the pit about 2 or 2½ yds. of material to obtain 1 yd. of gravel suitable for surfacing.

The gravel is loaded from the storage bin to the cars with a bucket loader driven by a gasoline motor, and hauled over a 24-in. gauge industrial railway. Whitcomb 7-ton gasoline locomotives are used with V-shaped gondola cars, equipped with side doors hinged at the top and latched at each lower corner. Two men dump the cars, one working on each side. The fenders have been raised so that they are a continuation of the slope of the car bottom, thus making the delivery of the gravel a short distance from the track. The cars carry 4½ cu. yds. each. One locomotive draws four cars on a 1 per cent grade. The highest weekly record made to date is 1,075 cu. yds. of gravel hauled an average distance of 2.14 miles, using one locomotive for empties at the storage and one for hauling on the road.

The rail and steel ties, used on the job were received, part from the War Department and part from the factory. These were piled at the camp and assembled into sections in the shade before being taken out on the road. This was found to be more economical than scattering the material along the road and assembling it in the hot sun. Six men with one locomotive and operator and one 20-ft. flat car, have picked up, hauled a distance of about 3½ miles, and laid ready for use, ½ mile of this track in one 10-hour day. This type of hauling apparatus is far superior to the use of trucks, or tractors and trailers for hauling wearing surface materials over roads composed of light soils as the roads in the Platte Valley of Nebraska are. It is especially advantageous in that it does not tear up the freshly graded road bed or mire down around the low, wet gravel pits, as the trucks and tractors do.

After the gravel is applied and the track taken up, the roadway is scarified and the gravel worked down. On this project the binder was applied and spread first and the gravel worked in afterwards. This is done to hold the gravel nearer the surface and prevent the sandy subsoil from coming to the top in excess quantities. This method has worked out quite successfully throughout the entire state of Nebraska.

SPECIAL METHOD OF HANDLING "SECOND STORY" CONSTRUCTION WORK ON STATE HIGHWAY IN LOS ANGELES COUNTY, CALIFORNIA

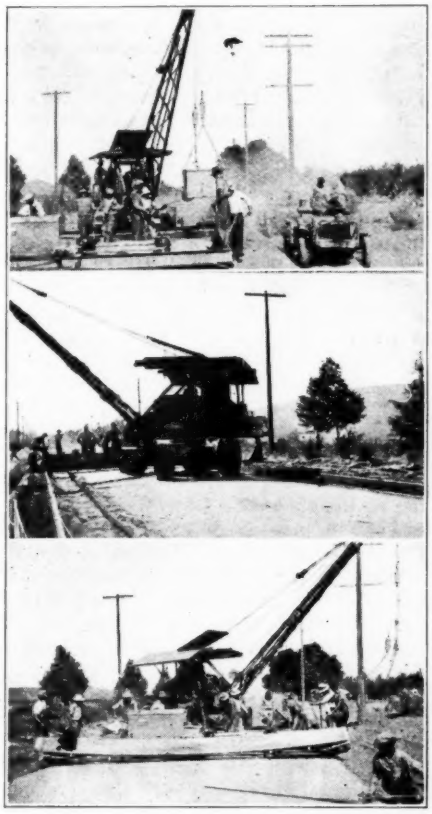
By W. W. Patch, Division Engineer, California Highway Commission, Los Angeles, Calif.

Due to the unprecedented increase in vehicular traffic during the past five or six years, certain of the state highway sections near the larger centers of population have been found too narrow properly to accommodate the travel, and in certain cases have also shown that thicker pavement is necessary to withstand the very heavy truck loads which are becoming a very large part of the total tonnage carried by a number of these sections.

The earlier concrete pavement built by the state averaged about 4⅜-ins. in thickness and 15 ft. in width, and it always has been the avowed intention of the commission to add to this base course an additional top wearing coat of substantial thickness which would result in giving much greater stability and longer life to the pavement.

During the season of 1919 and 1920 a number of miles of the pavement originally laid on Route 2 in Los Angeles County were widened and thickened to a total width of 20 ft. and a total thickness of from 6 to 8 ins. according to the local conditions. The pavement which was made 6 ins. in thickness comprises the adding of an asphaltic wearing surface from 1½ in. to 2 ins. in thickness over the original concrete base where the foundation course still remained in fairly good condition. In other places where the foundation was not in such good condition, the pavement was thickened by adding a reinforced concrete slab 4 ins. in thickness on top of the old pavement, plus shoulders of concrete on each side

2½ ft. wide and 6 ins. in thickness. The reinforcement comprised ⅜-in. square steel bars spaced transversely in the pavement 18 ins. on centers, together with a



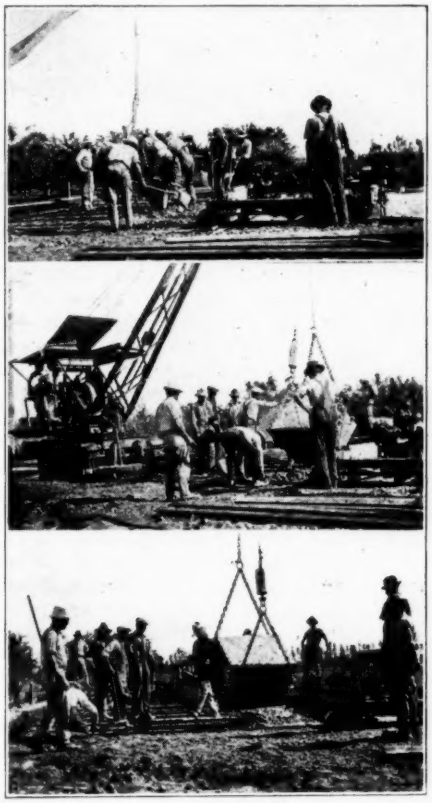
CONSTRUCTING "SECOND STORY" WORK ON STATE HIGHWAY IN LOS ANGELES COUNTY, CALIF.

Top: P & H Crane Handling 2-Ton Box of Mixed Concrete. Center: Excavating for Widening by Addition of Shoulder 8 in. by 2½ ft. Integral with Reinforced Top Slab 4 ins. Thick. Bottom: Austin Tamper with Crane in Background.

longitudinal ½-in. square steel rod spaced 3 ins. from each header and parallel thereto over which the transverse rods were hooked at each end. Between each transverse rod, a short steel rod of the same diameter and about 4 ft. long was placed to give additional reinforcement to the outer edge of the pavement on each side. The concrete in all cases has been mixed in the proportion of one part of cement, two parts of sand and four parts of screened gravel or broken stone.

Where the old base was badly shattered it was entirely removed and the new "second story" was extended through to the subgrade under the old pavement, making the repair of the old pavement integral with the new work.

Similar work is now being done connecting up a stretch about 9.7 miles long between two of the sections which were improved as hereinbefore described last year. The method of working is similar except that the 2½-ft. shoulder strip is now being made 8 ins. in thickness and the concrete is being mixed at a central mixing plant and is being transported in steel buckets holding each a four-sack batch. Upon arrival at their destination the batches are handled from the truck to the subgrade by a traveling crane. It requires about 20 minutes to make the



CONSTRUCTING "SECOND STORY" WORK ON STATE HIGHWAY IN LOS ANGELES, CALIF.

Top: Transverse Reinforcement Supported on three 2-in. Pipes. Center: Crane and Reinforcing Used. Bottom: Austin tamping Machine at Work.

maximum haul from the plant (5 miles) so that the time between mixing and placing under the conditions of longest haul is only about 25 minutes. In order to use this method successfully, the concrete has to be mixed very dry, and in the longer hauls hydrated lime is added during the

mixing at the rate of from 1½ to 2 per cent of the weight of the cement. After dumping on the subgrade the concrete is tamped by a mechanical tamper, and the result is exceptionally dense and smooth concrete.

The accompanying photographs show the method of handling this mixed concrete by means of a crane from the truck to its final position in the pavement.

The writer, as Division Engineer, had direct supervision of the work. Mr. Austin B. Fletcher is State Highway Engineer and Mr. T. E. Stanten is Assistant State Highway Engineer.

MODIFICATIONS OF IMHOFF TANKS

By E. A. Stewart, Associate Professor of Agricultural Physics, The University of Minnesota, University Farm, St. Paul, Minn.

I have read with a great deal of interest and pleasure the discussions for the past two years in Municipal and County Engineering, on Sewage Disposal Tanks. I would like to offer an explanation of the operation of the "Kirdorthoff" tank.

The difficulty with the Imhoff tank seems to be that the sludge becomes gas filled and rises in the gas well. This well is usually of so small a surface area that the gas cannot escape, and consequently the sludge does not sink again. The longer the scum is left the more leathery it becomes and the more efficient it becomes as a cover to hold in the gas. If a hole is punched through the thick leathery scum a considerable quantity of gas is always liberated. This scum will not putrify readily unless left where it can ripen.

The number of bacteria in this scum is considerably less than in the solution below. This would naturally be expected as the enclosed gases and other waste products would tend to sterilize the mass. In other words the gas cannot get out of the sludge; the sludge cannot sink; it becomes partially sterile; and the tank fails to function. Scum gathers to a thickness of 10 or 12 ft. in the gas well and perhaps 2 or 3 ft. in the sediment chamber. According to information available, this scum will not collect if grease, soap waste, or the like are not present. The large amount of undigested sludge present, however, is probably partially due to the fault of Imhoff tanks, mentioned by G. Everett Hill in the February, 1921, issue of Municipal and County Engineering. The bacteria may be decreased in number and vitality by not having the decomposition products removed from their workshop.

In the Kirdorthoff tanks these two defects are somewhat remedied. Bringing the fresh sewage in at the bottom evidently helps to carry out the waste products from the digestion chamber. At the same time the sludge is activated sufficiently so that, the particles of sludge come to the top when containing a small amount of gas only.

The ability of sludge to give up small amounts of gas when disturbed and also its ability to hold gas for 8 or 10 hours, and then rise and form a scum was noted in the Grand Rapids Experimental Plant. (See Municipal and County Engineering, issue of Feb. 1921.) This small amount is easily liberated and the sludge sinks again to the bottom. The action of the Imhoff tank at Ripon after turning the fresh sewage into the gas well exemplifies the above statement.

The main principle underlying the construction of the Imhoff tank is to separate the settleable solids from the raw sewage as soon as possible so as to get rid of the large amount of finely divided, somewhat colloidal material found in sewage when it stands for considerable time. Most of the solids in fresh sewage will separate, either float or sink, in one or two hours (creamery waste excepted). The liquid remaining between is quite free from suspended material, its turbidity being less than half the turbidity of the average tank effluent. The fresh sewage should then deposit its suspended solids and pass on out of the tank. This is accomplished in the properly constructed Imhoff tank but it is not accomplished in the Kirdorthoff or single chamber tanks. There are a number of Imhoff tanks, however, in which this is not so. The liquid stays in the tank so long that eddy currents through the long large slots intimately mix, the sewage in upper and lower story. Invariably the Imhoff tank operating on our greasy sewage, that does not give sludge troubles, that is, much sludge and thick scum in the gas well, has a very poor effluent. The analysis of the tank effluent of such a tank is given below. The tank effluent was very black and contained finely divided suspended matter that required 40 to 50 hours to settle out very much of it. The aanlysis is as follows in parts per million:

	Tank Effluent
Total Solids	1566
Solids in Solution.....	1450
Solids in Suspension.....	116

What can be done then to secure the

benefits of the Imhoff principle and yet get around the difficulties? It appears from our experience that a large surface in the gas well will help out. This is what is obtained in such tanks as the ordinary single story tank. It seems that we have been giving the sedimentation chamber the large surface area, and the gas well the small surface area, when this should be reversed. Many of the modified Imhoff tanks have been built with a larger surface area for the digestion chamber and these tanks give very little trouble with thick scum or sludge. The large area gives more opportunity for the escape of gases. This does not vary only directly as the area. For instance, with five times the area the same volume of scum will be only one-fifth as thick. The gas then has five times the surface to escape from and has only one-fifth as much scum to work up through. In addition, the gas does not have as much drying effect, and the scum is not so leathery and impenetrable.

We are installing a tank using this principle. This is a small private house tank but we may be able to secure some information on its operation.

Can the other trouble in the Imhoff tanks be remedied? That is can we supply liquor to the digestion chamber without losing the benefit of quick separation of sludge and effluent? I believe that this can be done by carrying one-sixth, or one-tenth of the incoming sewage which is fresh into the digestion chamber direct. The correct proportionate part must be determined by experience. We have no data on this at present but we would like to hear from anyone that has.

There is also a point in the method of operating that I would like to see discussed in Municipal and County Engineering. Should the tanks be operated open or closed in the summer? The only report I have available is the one by Rideal on the tanks at Exeter and Davyhulme. Along with this we probably will have to consider whether the closed tank has any ventilation. Dr. W. Ramsay Smith, of Sidney, South Australia, states that ventilation in the last stages of tank action is beneficial because of some oxidation and nitrification that is being brought about.

BRITISH VIEW ON ADVANTAGES OF BITUMINOUS MACADAM

By Alfred Dryland, County Surveyor of Middlesex, England.

(Editor's Note: This interesting summary of the advantages of bituminous, as compared with waterbound macadam, was presented by Mr. Dryland at the conference of the Institution of Civil Engineers held in London, England, on July 1, 1921.)

For the purpose of this paper the author includes all bituminous matrices used in modern forms of road construction, whether the product of destructive distillation of bituminous coal, such as tar and pitch, the residuals from oils with a bituminous base, or natural bitumens.

The chief advantages of bituminous macadam over waterbound macadam arise from:—(1) Superior cementitious qualities, (2) exclusion of water, (3) resiliency, (4) facility for repairs, (5) economy.

Cementitious Qualities

Waterbound macadam is only held comparatively firmly in place under conditions when moisture is just sufficient to fill the voids in the sand or detritus between the macadam. An excess, or lack of moisture, over or under this standard, results in movement of the aggregate, causing internal attrition, tending to round the arrises, and eventually leading to loss of cohesive stability. With horse-drawn vehicles, mainly iron-tired, the traffic had considerable consolidating powers, and waterbound macadam, except in extremely dry or excessively wet conditions, served satisfactorily on the whole to carry traffic up to a very appreciable tonnage, rendering paving only necessary under the heaviest conditions, mainly in town streets. The advent of the self-propelled vehicle, with its generally higher unit weight, greater speed, and more concentrated propulsive adhesion, caused greater disturbance of the aggregate. The weak concretive effect of the void filling was altogether inadequate to prevent movement, and rubber tires tended to remove the filling between the aggregate.

The first effective step in the process of bituminous binding was the adoption of a dressing of coal-tar, which percolated into the filling material between the stone and had considerable effect, from the action of the pitch contents of the tar, in holding the aggregate firm. It was largely assisted in this process by its power of preventing the infiltration of moisture which had previously acted as a force tending to assist movement and also to increase attrition. The tendency of tar, owing probably to its specific gravity, is to percolate downwards, and repeated coats of this simple and comparatively inexpensive dressing, under limited conditions of traffic, produces a bituminously bound and waterproof macadam road,

which, in favorable situations, serves to carry satisfactorily at the present time a traffic up to some 300 tons per yard width per day, even when the traffic has become mainly self-propelled, so long as it does not consist of an undue proportion of rubber-tired heavy vehicles, such as buses. When the surface coating remains complete and waterproof through the winter, nothing better can be desired; but in damp situations the tarred surface is destroyed in the winter time, and both surface attrition and disturbance of aggregate come into play.

Exclusion of Water

To avoid these troubles and effect further adhesion and more complete waterproofing, the expedient of forming a tar-concrete has been adopted, and this, when a suitable aggregate is used, has become a common form of road coating, capable in favorable situations of carrying for several years a main road traffic, including motor buses and other heavy cars, aggregating 500 tons per yard width per day. On the question of aggregate for this purpose the author unhesitatingly puts forward the view that blast furnace slag is far and away the best material for the purpose. He further asserts that a good quality limestone or calcareous sandstone takes second place, and the hardest and best granites form the least satisfactory aggregates. A tar-macadam which compacts, as slag does, into a concrete mass becomes completely waterproof.

Other bituminous methods, such as pitch grouting and so-called "asphalt macadam," which usually consists of a bituminously bound coarse aggregate base covered with a carpet of extremely fine aggregate, generally termed sheet asphalt, is completely waterproof, and although liable to shallow surface distortion, due partially to traffic displacement, but partly also to temperature changes, affords a smooth and substantially non-"attritive" surface of great durability. Granited mastic asphalt and natural rock, the latter laid in powder form, are other well-established methods of providing waterproof and durable carriageway pavings.

Resiliency

All bituminous concrete aggregates undoubtedly have a considerable measure of resiliency which enables them to endure without material damage the shocks and stresses imposed by the impact of wheels of heavy vehicles. They suffer a large amount of distortion without breaking. They have considerable powers of recovery. An interesting subject for discussion is the question of resiliency. It is often claimed these pavements are most durable when voidless. The author would suggest the contrary—namely, that while they are compressible the wear from attrition is small, but when the faculty of compressibility is lost "attritive" wear becomes comparatively rapid. A case which would seem to refute this theory is that of rock asphalt, which, being formed of impalpable powder closely compacted and laid on an incompressible concrete base, would closely approach voidlessness. The author can only suggest that there remains a small measure of compressibility in the thickness of the coating, which is generally 2 ins. in depth. When the thickness is materially reduced it tends to crack and eventually break up.

Repairs

All bituminously-bound roads lend themselves to the process of patching repair, inasmuch as it is easy to cut out defective sections and resurface. The author suggests the chief factor in this process is the provision of a sound abutment for the patches, which can be let in and the joint completely sealed. It is very difficult to effect similar repairs to waterbound macadam owing to the instability and easy displacement of the abutments.

Economy

Economy is found in the comparatively long life of bituminous work compared with waterbound macadam. The test of economy of a road coating, from the expenditure point of view, is gauged by the first cost and maintenance charges divided by its effective life. It is difficult to give specific instances of the relative cost of waterbound and bituminously-bound roads because the traffic changes are progressive and variable both as regards weight and units and speed. Moreover, in certain cases, waterbound macadam has been found entirely impossible to maintain in a state to carry the traffic satisfactorily. The author has, however, knowledge of specific instances where slag tar-macadam has been maintained for the last 16 years at a less cost per square yard than the previous waterbound macadam surface entailed at that remote period when motor cars were few and the heavy type were unknown. Further instances are within his knowledge where waterbound macadam from 1908 to 1911, although surface-tarred, could not be maintained for more than three years, whereas the tar-macadam, which was substituted, has lasted so far ten years, not-

withstanding the great increase in weight and speed of traffic, while the cost, including maintenance, would not exceed that previously incurred in maintenance in waterbound macadam.

The author puts forward as a general proposition that the life of a well-constructed bituminous road surface may be taken to be at least three times that of a waterbound macadam, and that its economy is self-evident, and that it has the additional advantages of cleanliness and lessened tractive resistance.

HUERFANO RIVER CONCRETE HIGHWAY BRIDGE IN COLORADO

By Robert Dubois, Bridge Engineer, Colorado State Highway Department, State House, Denver, Colorado.

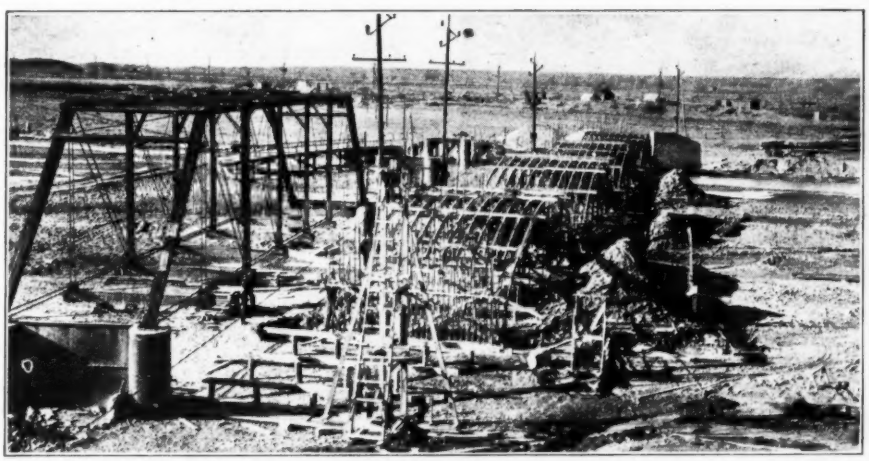
There is just being completed for the Colorado State Highway Department, one of the largest concrete bridges in the state. It is about 20 miles east of Pueblo, across the Huerfano river, on the New Santa Fe Trail, a highway that is not only the main road in the Arkansas valley, but also is the artery for the heavy tourist traffic from Kansas, Oklahoma and Texas to the mountain playgrounds.

The former bridge across the Huerfano was of combination trusses, built almost 30 years ago, two spans of which failed, because weakened by the drillings of woodpeckers at the hip joints. The new bridge is of concrete arches, five 80-ft. spans. The foundations all reach bed rock, though at one end, it was necessary to go down 20 ft. below the stream bed. The cofferdams were sheathed with a single layer of Oregon fir, two by sixes. That the cofferdam for the 20-ft. hole had to withstand considerable pressure is attested by the fact that a piece of fir 2 by 6 incorporated into the waling came out only ¾-in. thick. In spite of this pressure, however, no great difficulty was experienced with the cofferdam, which did not make at any time more water than a single 6-in. pump could handle.

After the normal time for trouble from floods had passed last fall, excavation for the stream piers was begun. When one cofferdam was down about 8 ft., and another all assembled, the river came up and removed them, taking along also some of the equipment. All of the equipment, however, was later recovered, except a small pump. After this, no more trouble was encountered with the weather —the winter being exceptionally open, never interfering with the work.

Piling for the centering was cut locally by the contractor, cottonwood being used. Five-pile bents, on a maximum of 12-ft. centers were used. The segments were made of narrow strips cut to the curve of the arch, nailed onto two by twelves. These were lagged with two by sixes. The centering for all the arches, and the outside forms for the spandrel walls, were finished, and the arch steel all tied in place, before any of the arch concrete was run. Once started, however, one ring 5 ft. wide was poured over one arch each day, giving a high yardage for the contractor's estimate that month.

The spandrel walls required considerable care. Not only was it necessary to pour a vertical lift of 18 ft. in a continuous run, but, there being no overhanging bandrel along the top, especial attention



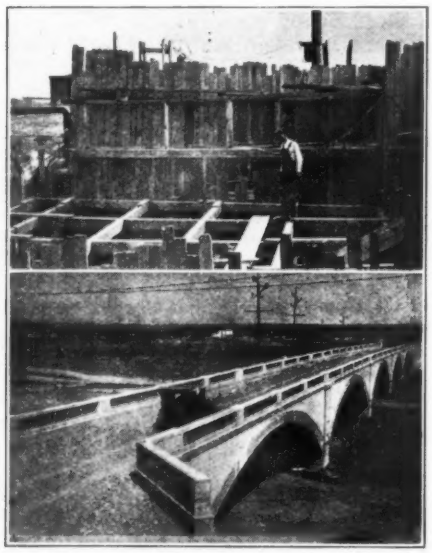
CONSTRUCTION VIEW ON HUERFANO RIVER HIGHWAY BRIDGE IN COLORADO.
From Left to Right: Temporary Bridge; One Span of Old Steel Bridge; Ribs for Centering of New Concrete Bridge.

had to be given the bracing to achieve a true, plumb, wall. Excellent results were attained.

After much of the dirt fill was in place, the centering was struck and the handrail poured. Here again much attention was given to attaining true lines, with the desired results.

The concrete work was almost done, when the flood of June hit the Arkansas Valley, tying up temporarily most of the roads. Part of the old temporary crossing was taken out, and since bridge timbers were badly needed for temporary bridges on other crossings, it was decided to open the new bridge for traffic, incomplete as it was, and not attempt to repair the old bridge, but instead to use that bridge material for a temporary bridge over the St. Charles River, near Pueblo.

As soon as the concreting could be finished, and enough more dirt thrown in to make even a moderate roadway, the con-



VIEWS OF HUERFANO RIVER CONVIEWS OF HUERFANO RIVER CONCRET CRETE HIGHWAY BRIDGE IN COLORADO.

Upper View: Cofferdam for Abutment Sunk 20 ft. and Cofferdam for Wing Adjoining Down About Half Way. Lower View: A General View of the Bridge.

tractor's forces were taken off to construct a number of pile trestles at other points where bridges had washed out. These done, the fill was again attacked. A considerable fill is being put in on the Pueblo end, improving greatly both the grade and the alignment. This fill is rapidly nearing completion.

The Santa Fe Trail will be concreted, from Pueblo east to this bridge, within a few years. When that time comes, it is planned to pave right on across the bridge. Until then, the roadway is being graveled. The new bridge will remove the danger from a bad section of road, there having been a sharp, blind turn down a steep hill to the valley. The new bridge will have straight approaches on easy grades.

The bridge was designed for the State Highway Department by the writer, who also did the resident engineering work during construction. It was built by the Pueblo Bridge and Construction Company, under contract. Their foreman was Thomas Gross, who produced a bridge of unusually good appearance.

SUGGESTIONS ON THE DESIGN OF TILE DRAINAGE SYSTEMS

By J. W. Dappert, Consulting Engineer, Taylorville, Ill.

Without attempting to go far into the past, and without digging up some of the tile-drainage systems put in by Nimrod along the Tigrus River Valley, 1300 B. C., by Vitruvius, and other engineers in Rome from 753 B. C., to the present date, or without examining the terra-cotta pipes laid by Sir James Graham at Northumberland, England, in 1810, and those installed by the venerable drainage engineer, John Johnson, at Geneva, New York, from 1835 to 1858, we come, by easy stages, to present day practices and methods of tile drainage in the Mississippi Valley, and especially in Illinois, said Mr. Dappert, in addressing the Illinois Society of Engineers at its 1921 meeting.

The earlier work of tile-drainage in Illinois was not done in accordance with well established rules or reasons, but was rather by a haphazard "hit or miss" method. Also, I fear that the practice has not yet reached the stage where it is a purely scientific operation based upon rational and wholly deducible formula and rules. In the very nature of the work, being carried along mostly by individual enterprise and with little supervision or aid from any governmental agency, there has been no time or funds for going deeply into the rather intricate scientific problems which confront the average user of tile drains, whether land owner or engineer.

Testing Tile

The Iowa State College at Ames, Iowa, has gone rather fully into the subject of

bearing strength of drain tiles, and the American Society of Testing Materials has adopted a tentative method of testing drain tiles and a set of uniform specifications for materials and manner of installing them; but the equipment required to carry out the tests, and possibly the time and expense of both money and brain power necessary to execute them has been a deterring factor against their universal use. When facilities have been provided by the state enabling tests to be made of each carload of drain tile before it leaves the factory, and without direct expense to the purchaser or user, I apprehend that the standard specifications will become almost universal, but at present they are not generally used, and cannot thus be used. A few farmers or land owners frequently have a small joint drain to install, requiring the use of from one to ten cars of drain tile. It is manifest that they cannot afford to pay from $10 to $40 per car for the tests to be made in standard manner, so most of the engineers of this state are going to continue to inspect and reject tiles upon their general appearance as to color, soundness, freedom from cracks, checks, blisters, or other defects, and upon the general reputation of the manufacturers, as we have had to do in the past. Now this should not be so, but until some practical method of application of standard tests and specifications can be put into effect, it cannot be otherwise.

An Experience With Poor Tile

Some of the difficulties which I have found and partly solved in the most practical way at hand may be of some interest. In one instance, about 12,000 ft. of 30-in. vitrified salt-glazed drain tile were being installed, with flat gradient 0.03 ft. per 100 ft., through city streets under pavements, incidentally crossing 5 main lines of railroad tracks and about 20 side tracks. My specifications, made before standard specifications had been worked out, required cast iron pipe 30 ins. in diameter, to be installed under the tracks, and also required drain tile to be of first class quality in all respects, with the usual "terms of endearment." Other portions of the specifications required the contractor to complete the drain and accessories and put them in good working order throughout. He was required to furnish all materials and prices were by the lineal foot. This drain was so situated as to have but 9.6 ft. fall in a distance of about 10,000 ft. This fall could not be increased without dredging work, which would involve perhaps a million dollars and affect the riparian rights of landowners in two different states. Added to the difficulty of gradient and that of railroad track crossings was the natural difficulty of much fine sand in the soil. Fortunately the grade had to be placed so low down as to be wholly under all the former works of man. The borings taken showed that we had a stiff yellowish blue clay at grade of drain. The contract for construction was let about March 6, 1913, at a time of slightly ascending prices, but four or five bids were had at or near the engineer's estimate, and all went well until about 1,000 ft. of the drain tile had been delivered upon the line of work. The first impression upon seeing the tiles was that they were rejects, as some of them had yellow clay adhering to them, although the top soil for several feet in depth of the contiguous land was all quite black. I see now that I should have rejected the entire lot bodily as not being of standard thickness under the specifications, but my idea was that it would cause considerable loss to some one, and delay to do so.

The contractor said he had purchased them under a guarantee that they would meet the specifications, and, if they did not, neither he nor we had to pay for them. Under this arrangement about 40% of the tiles were culled out and the construction began. After many changes in alignment and some changes in the contract, which changes were constantly being sought by the contractor, the work progressed about 800 ft., where depth of backfill upon the tiles reached 7 ft.; practically all the tiles were ruptured by the dead weight of earth in the trench. The final outcome of the trouble was a rejection of all the pipe, a new contract let at 20% advance in price, and two years' delay in completion, with a lengthy trial in the District Court, and a "hung jury," so that not any of the pointed questions raised were ever really determined, and I do not know whether the provisions of my specifications were good or bad. The work was finally completed by the third contractor, and 800 acres of marsh, always heretofore a stagnant pond, full of mosquitos and miasma, converted into small truck farms and gardens which produced bounteous yields throughout the world war.

Some Lessons Learned

The lessons learned from this experience are: First, make your specifications and contracts very explicit and definite, and as brief as possible under

the circumstances. The Court loves a brief contract, if it ever reaches court. Second, if it is evident that the contractor is seeking to make his profits by evading the plain terms of the agreement rather than trying to perform them in a practical way, and hopes to profit by trial in court rather than by miles of work performed, then get rid of that contractor by all means and re-let the work. Third, do not presume that all kinds of difficulties have been met, overcome, and reported at length in the society proceedings or journals of various associations, because there is a crooked contractor coming who will readily devise some new difficulty that you have not encountered. Hence, the lesson to be learned here is to look well into the character and ability of the contractor to whom you award important works.

Topographic Surveys

The drainage engineer is frequently presumed to be able, at a glance, to determine the topography of the land sought to be drained, its fall to the outlet, surface slopes, soil characteristics, and all other physical aspects, but usually he cannot do so. Hence, to determine the plan of drainage so that it can be most economically installed, a topographical survey is a necessary part of the expense of construction, and a plan should be evolved which can be, at once or at a later date, put into execution. This topographic survey should include the determination of elevations, sufficient in quantity to make a close topographic map. Do this by stadia readings, if you like, but I find that I can cover more ground per day with a Wye level, using a small pocket compass and level combined, to fill in the more minute details, and in this way cover an area of from 100 to 300 acres per day. The more flat and level the tract, the longer I make the station intervals, and the more rolling the tract, the more carefully should the elevations be taken, that is, within reasonable limits, upon such lands as ordinarily require tile-drainage. Usually the elevations are taken at intervals of 100 ft., while for very flat lands they may well be taken at intervals of 300 ft., but in either case the location and elevation of all depressions, ridges, extremely wet spots, ponds, streams, fences, buildings, and trees should be taken, and their location and elevations determined sufficiently close for platting. While this is going on, test pits should be dug, the soil investigated, elevation of any hard or soft strata determined, samples of any unusual varieties of soils taken for future test and study, and all this data be finally platted upon the map of the area.

During this preliminary survey and investigation it may also be necessary to make a survey for some distance away from the tract in question, to secure a proper outlet, and a close sketch of the creek, branch, or other water course and its surrounding objects should be made, with measurements sufficient to design a proper bulkhead or retaining wall at outlet of tile drain. This survey should also be made with a view to the possible construction of catch basins, inlets, or wells, at the points where they will best serve their functions. These should be placed at fence lines where possible, or at the margins of fields, where they will be least in the way of cultivation or use of the land. It is better to take all possible data of this kind while making the topographic survey, rather than to have to make another long trip later on to secure one or two of the most important facts found to be needed. A day's time extra on the preliminary survey may easily save several hundred dollars in the final determination of the most feasible plan of drainage, and I think it best to get all the data rather more minutely than necessary, as being an error in the right direction.

Utilizing Old Tile Drains.

Frequently, in a topographic survey of this kind, it is found that some sort of a haphazard system of tile drainage has been heretofore laid upon the land, with tiles generally too shallow properly to drain the land. Indeed, it would be difficult to find many tracts of land in the corn belt of Illinois that have not one or two tile drains laid. These should be followed out and their locations determined as much as possible, and that is done by digging holes or trenches where the tiles are suspected, until a mixed soil is found, indicating that the soil has once been dug, and by perseverance and a little experimenting, these old drains can generally (but not always) be traced. Some of the older tiling contractors whom I have known are quite frequently adept at this kind of work. Having found these tiles, they should also be platted from measurements, and have their grade lines marked at intervals upon the map. If such old tiles are found to be filled with a deposit of mud, or are 4 ins. or smaller in size, and are so situated as not to be of much utility in the plan of drainage, they ought not stand in the way of designing a proper

system of drainage, and should be ignored. Where it is found that such old tiles are helpful in draining the lands, are in good general condition, and are laid in the natural course of drainage, they may be utilized in the new plan, and the new drains so designed as to conform with them, or very nearly so. Each tract of land should form a separate study, a separate problem, and be worked out to effect the final drainage in the most economical manner. It is the function of the engineer to provide the drainage in the most feasible way, at the least expense, and with the best possible results. Some determination of soil conditions can be had while the holes are dug for purposes of finding the old tiles.

Where, as frequently happens, some of these old drains are missed in the preliminary survey, but are found in the actual construction of the new drains, and are frequently found in good condition and performing their work, it may be desirable to maintain them. This is easily done where new grades are shallower than the old, but most frequently they are the reverse. Where new drain goes under the old, if found in good condition, the latter may be connected by means of a Y junction to the new drain, stopping up the dead end of the old drain by means of bricks and cement. Again, it may be desirable to pass the old drain over the new, in its original course. This is done by building up a mass of concrete, using pieces of broken tile where space is large enough, in such manner that the water will not pass from the old to the new drain, causing wash and displacement of the drain. Where grade of old drain is slightly higher or lower than that of the new drain, and not large enough to admit of junction with each other, a small sub-surface well of brick, laid in cement, can be built with 50 bricks, a bucket of cement and two buckets of sand, which will enclose both drains and allow the water to go to either the old or the new drain, whichever has the least resistance. I have employed all these methods at various times. The passing of one drain over the other must be well done, using cement and tile bats, as suggested, to prevent damage to one or the other of the drains. The little detail of stopping up all dead ends of tile drains by some permanent kind of plugs is of as much importance as the laying of the drain in the first place.

Design of Tile Drainage Systems

With a close topographic map before him, the engineer begins a study of his problem, be it intricate or simple. All time spent in study upon it is justified, for upon the proper design largely depends the success of the enterprise. The old tiles found upon the tract may easily be a deciding factor in determining which one of two possible plans is best. Where areas are flat and the contours rather far apart, the plan should be to cut the contours at right angles, as nearly as possible, with the drains. When you design a system with the laterals spaced parallel to each other at regular intervals, it will often be found that you cannot locate all of them at right angles to the contours. I would allow considerable leeway to this rule, so long as the laterals in regular spacing will cut the contours at an angle up to 45 deg. from perpendicular, after which a new main or sub-main should be installed, in some "thalweg" or depression, which will admit of a considerable area being reached with a parallel system of drains.

Where flat areas are found covering considerable territory, it will be found necessary to insert some sub-mains at intervals, rather than to carry the lateral drains for long distances upon too flat a grade. Also, this method saves going very deep at lower end and very shallow at upper end of lateral, the sub-mains being held down to flatter gradients and made sufficiently large to carry the water from the laterals. Upon lands which are rather rolling, it is found that no regular rectangular or gridiron system of lateral drains is applicable, and in my opinion this kind of land is the most difficult upon which to plan an elaborate system of drainage. The low swails rapidly catch the waters from the more rolling lands and become supersaturated, hence the lateral drains should be provided with more capacity than for flat lands where the accumulation of water is more gradual. In other words, the portions of a hilly farm that require tile drainage at all require tiles of larger calibre than those upon more level land, if you wish to get the water into the drains rather than to have it run away upon the surface, and thus prevent soil erosion.

Where flat areas join precipitous areas, the laterals will generally need to extend well up the slopes, to cut the seepy spots, and should extend to the summit, or very nearly so, and the drain which goes far enough above the point of seepage so that its grade line is about level with the place where seepage discharges will be of more value for drainage than the lateral which goes directly through the

seepy spot itself. The reason for this is that the seep itself is caused by a stratum of soft, water-bearing soil overlying a hard, impervious stratum which holds the water and carries it out to the end of the stratum. Often these hard strata dip away from the draw or natural depression rather than toward it, as might be presumed, so that considerable exploration by boring or test pits is desirable upon such rolling lands. This inversion of dip, and many other intricate details of soil formation, are due to the pressure of the ice sheet during the glacial epoch, and to subsequent erosion.

The several different glacial invasions coming from different sources, or from different directions and at different times at least, have also complicated our soil conditions, and are a great study in themselves, not to be treated at great length in a paper of this kind. Suffice it to say that the drainage engineer should inform himself as much as possible about soil formations, soil characteristics, and when he becomes familiar with the various features of soil in a given locality he will be able to forecast, from surface appearances, some of the peculiar and well defined characteristics of soil strata wherever he sees them. This statement is especially true of soils in the upper Mississippi Valley, with now and then such a notable exception that a special study should be made of such exceptional features.

Depth of Drains

The depth at which tile drains are laid or should be laid is dependent largely upon the character of the soil. Usually the tiles work best when laid just a few inches below the base of the soft, water-bearing stratum, and within the hard bottom below it; but it is evident that with a drain laid to a regular gradient this is rather difficult always to accomplish and keep upon straight lines, hence the more need for the test pits and a study both of topography and soil strata. Where the topography is rather precipitous, contour lines close together upon the plat, the cutting of the contours at right angles may not be the most desirable method of location of the drains. It frequently happens that a direction oblique to that of the contours may give the best results, and if a single drain does not cut off all the seepy places the next parallel drain will do so. If I have made it plain that considerable study of soil conditions and topography are worth while in a tile-drainage project, I have accomplished my purpose, and leave it to the ingenuity of each individual drainage engineer to work out for himself the methods of determination.

As to the depths at which tiles should be laid, I find that I cannot always secure as great depth as is desirable, in flat areas and can secure too great depth in more rolling areas of land. In other words, where the tiles could properly be laid to a good depth the topography is such as not to admit of it, and where the topography will admit of deep drains, as on rolling lands, the soil conditions are such that the shallower drains will better serve the purpose. I think most drainage engineers have found this true. Now, as to what depth and space intervals are best—each drainage area is a separate study by itself, and no one can say, except by a study of all the conditions, or by experiment. I have laid tile drainage systems with laterals spaced 200 ft. apart and secured fairly complete drainage upon rather flat land with very friable soils. Again, I have laid the tiles 132 ft. to 140 ft. apart upon rather rolling lands and afterwards found it necessary to double up by laying one new drain between each of the two older drains, to accomplish the same result. Upon the rolling lands the soil is, most generally, not so friable as upon the flatter lands. Also, a drain laid upon a hill slope does not reach out far to draw the water upon the down-hill side, hence the spacing must be close enough so that the contiguous drain will draw the water from the soil upon its up-hill side, from near the locality of the next drain. Again, a study of each area is a necessity to be able to properly design the system and to determine the distance apart of the drains.

Inlets and Catch Basins

In many localities where surface run-off is great, it will be found necessary to install inlets and catch basins. This is especially true of the more rolling lands, where small branch drains, ditches, and water-ways have been made or washed out by erosion. Upon such lands the soil and sub-soil are frequently impervious, or partly so. The water cannot percolate down to the tiles as rapidly as it falls during heavy rains or in melting snows. It forms rivulets and washes away the top soils, and impoverishes the land. A catch basin, usually dug circular like a well, lined with brick or concrete, with its base also lined, and made from 2 to 8 ft. deeper than the outgoing tile drain to form a silt basin, should be installed at fence lines where possible, so

as to be least subject to injury by stock and from farming operations. Where necessary a small pen can be built to protect it. These catch basins should have a grated iron frame and cover similar to city catch basins, and, if necessary to install in a field under cultivation, may be left several feet below the general surface, at top of grate, and have a load of broken stone or gravel thrown over the top through which the surface water readily percolates.

Where drainage areas are small a T junction can be placed vertically in the tile drain and a run of pipe carried up to the surface, with a grated iron cap and cover. If in the fields where they would be subject to being damaged or broken they can be covered with brick bats, tile bats, gravel or a mixture of any of these, and will admit surface water and prevent erosion. It is needless to say that all such devices for surface water admission offer a variety of forms of construction, depending as to economical qualities upon the conditions in the locality. But it is more economical in the end to provide some durable design which will not readily decay, such as concrete, iron, stone, or vitrified clay pipe.

Where a system of water inlets or catch basins is designed as a part of the system of drainage, it is evident that greater run-off must be provided for than if merely drainage by percolation, and the tile laterals and mains must be increased in size to allow for this, or otherwise the basins and inlets will not accomplish their purpose, to prevent soil erosion.

Rainfall and Run-off. Sizes of Tile Drains

Just how large a drain should be to serve a certain area is quite a nice little problem in itself. It has often been solved by guess, by engineers and others. The land owners who pay the expenses often determine upon the sizes to be installed, but the engineer is usually called upon to use his skill and judgment in deciding the kind, sizes, and character of drains needed. I note with gratification that those engineers who depend largely upon guess work are dropping by the wayside, and the engineers who determine facts by reasoning and by scientific investigation are coming into favor, for the employing public is learning to appreciate experience, education, and scientific design, in all fields of endeavor.

The study of rainfall is a great topic. In the state of Illinois the variations of annual precipitation are as great as 14 ins., which is 33% of normal precipitation in this state. The rainfall records of the U. S. Weather Bureau show as much as 11 or 12 ins. rainfall in 24 hours in restricted areas, and in unusual floods. The run-off records in the state vary from practically zero to as great as 5 ins. in 24 hours. By taking the extremes in any case we can arrive at no safe and sane conclusion as to how much run-off to provide against in designing a system of tile drainage. We depend largely upon experiment and former experiences as to what is feasible and proper to provide for.

(To be Concluded in October Issue.)

ENGINEERING FEATURES OF STATE PARK AT GRAND HAVEN, MICHIGAN

By William M. Conley, County Road Commissioner, Ottawa County, Grand Haven, Mich.

By the action of the City of Grand Haven in presenting a valuable 10-acre park site along the shore of Lake Michigan to the Michigan State Park Commission motorists have been given direct access to the beach over paved roads, parking space has been provided close to the shore line for hundreds of cars and a delightful playground has been opened to the thousands of tourists who flock to Michigan every summer. The Grand Haven park consists of 10 acres of broad, clean sand beach, located at the terminus of Trunk Line Highway No. 16 and along Trunk Line Highway No. 11, the latter being known as West Michigan Pike, both highways being paved down to the entrance to the park.

At most points nature has barred access to the beaches through the great bluffs and huge sand dunes. The Grand Haven State Park is one of the few points where public improvements have been carried on to an extent that has overcome these barriers and the tourist easily reaches the lake over a fine pavement. Private interests heretofore have monopolized the more accessible points on the lake front and the movement of the State Park Commission is regaining the privileges which never should have been denied the public.

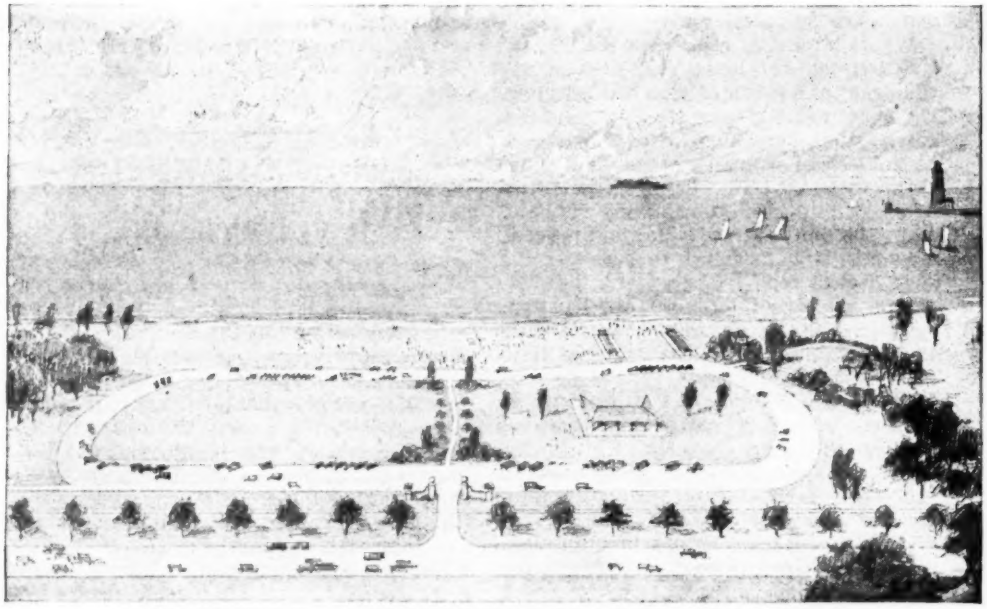
The paving at the State Park for the accommodation of the many visitors consists of a great concrete oval 2,100 ft. in length with a paved width of 25 ft. to be ultimately widened to 50 ft. Parking space for automobiles is provided around the entire oval and 2,500 cars were parked there the first Sunday following the open-

ing day. The park was opened June 26, 1921.

The ultimate plans of the local park commission include the erection of bath houses, comfort stations, playground equipment and a commodious shelter house. A life-saving patrol of some kind will be established for the protection of the thousands of bathers. A landscape architect has in charge the beautification of the park by planting ornamental shrubbery and such trees as can be induced to grow in the clean, smooth sands common to the Lake Michigan beaches. The present city-county highway connecting with this park will ultimately be projected as a boulevard northerly and easterly to form a concrete loop about the city and will provide a choice of routes to the park.

Ottawa County has a great building program of concrete roads under way. This season will see the completion of the concrete paving from Grand Haven to Holland, a distance of 22 miles. From Grand Haven to Grand Rapids, a large part of the distance will be paved during the season, the distance being 32 miles. Muskegon lies 12 miles north of Grand Haven and a fine highway connects the two cities. The City of Grand Haven is now paving its streets with concrete exclusively and the paving laid more than seven years ago is still in excellent condition. The paving is done by force account under the efficient management of Paul R. Taylor, City Manager. A program of paving has been laid out two years ahead and the City Plan Commission has tentative plans considerably beyond that period.

The construction of the State Park at Grand Haven is only a part of a large plan laid out by the Michigan State Park Commission of which Mr. Fred Pantlind, of Grand Rapids, is an aggressive member. The Ottawa County Road Commission encourages and lends its aid to all public improvements that in any way benefit the motoring public and it has been an important factor in this particular instance.



DRAWING OF THE STATE PARK AT GRAND HAVEN, MICHIGAN.

PROTECTING PAVEMENTS ON CAR TRACK STREETS

By H. A. Nunlist, Consulting Engineer, 1309 *Traction Bldg., Cincinnati, Ohio*

When a city is ready to proceed with the improvement of its street car streets, the car company frequently is not financially able to carry on the improvement of its right-of-way. The result is to delay the improvement until such time as the company feels it can conveniently stand this added expense. In many cases the tendency to delay reconstruction is augmented by the fact that the rails are in daily use, no consideration being given to the public using the pavement outside of the rails.

SHOWING GRANITE HEADER IN PLACE—CAR TRACK PAVING NOT DISTURBED —AND POURING TEXACO NO. 39 ASPHALT FILLER ON CARTHAGE PIKE, ST. BERNARD, OHIO.

Work at Norwood, Ohio

For a number of years the principal street in the city of Norwood, Ohio, was badly in need of improvement. It was very difficult to get the city and street railway officials together. In 1915 plans and specifications were prepared by the city engineer for permanent improvement of the city's section of the street, and his solution of the problem has proved so satisfactory that many engineers elsewhere are employing the same method.

A granite header was placed at the end of the ties on a concrete bed 6 ins. deep. The header was placed to act as a curb to hold the street pavement in place, and work progressed in the same manner as paving a narrow street. Later the street car section of waterbound macadam was easily improved.

The granite header, 4 by 10 ins., and in sections of from 3 to 5 ft. long, not only solved the engineer's problem of satisfactorily improving this section of the street, but it also demonstrated conclusively that the street car company could carry on the improvement of its right-of-way without disturbing the adjacent pavement in any way. Not only was the pavement left intact after the street car section repairs had been made, but the header effectively served to limit the shock due to the impact of the moving street cars because of uneven rail joints, flat wheels, etc.

CARTHAGE PIKE, ST. BERNARD, OHIO, SHOWING NEW GRANITE PAVEMENT WITH GRANITE HEADER AND TEXACO ASPHALT FILLER, WITH OLD CAR TRACK PAVING LEFT UNDISTURBED.

At Chicago, Ill., and St. Bernard, Ohio

The city of Chicago employed the granite header in 1919 with such success that the Board of Local Improvements now requires a header on all street paving improvements carrying street car rails.

The city of St. Bernard, Ohio, is well pleased with the repaving of Carthage Pike, the main thoroughfare of the city, which work is being carried on without the street car company repaving its section of the street. The joints of the pavement are being filled with Texaco No. 39 asphalt filler to insure a water tight joint and also to allow for expansion and contraction of the header due to temperature changes.

What the Granite Header Provides

The granite header provides for the following:

First. The reconstruction of the city section of a street independent of street railway company and permits either interested party to repair its pavement area without interfering with the other.

PAVEMENT RECONSTRUCTION ON WABASH AVE., CHICAGO, SHOWING GRANITE HEADER AND NEW PORTLAND CEMENT CONCRETE BASE IN PLACE, STREET CAR RAILS AND PAVING NOT DISTURBED.

Second. An insurance on the life of the city's section, as the header serves to limit the effect of the street car traffic shock, which has been found very damaging to pavements where a division of sections is not made.

Third. City can construct its section without awaiting time for street railway company to finance its section.

Fourth. The top of the header is flush with the pavement, and furnishes a uniform surface.

This method of construction has proven its worth, and can be recommended highly.

HOW HALIFAX WAS REBUILT

By Jacob L. Crane, Jr., Charlevoix, Mich.

(Editor's Note—Mr. Crane collected the material for this article while on his town planning trip through Canada and Western Europe, editorial reference to which was made in the March, 1921, number of this magazine. While Mr. Crane is still abroad, correspondence to the address above given will be brought to his attention).

Under the administration of the Halifax Relief Commission nearly thirty million dollars have been expended in temporary and permanent relief; in re-planning the 325-acre devastated area; rebuilding nearly 600 destroyed houses; completing about 15,000 repair jobs; and adjusting over 16,000 personal claims. In addition to its magnitude, the reconstruction work is notable because it has greatly improved the character of the ruined area by the scientific re-planning of the streets and by the construction of better-situated and better-designed houses in place of the destroyed ones.

In the explosion which occurred December, 1917, in the Halifax harbor, 1,600 people were killed, 6,000 injured, 1,600 buildings were destroyed, and upwards of 12,000, within a radius of 16 miles, were damaged. An entire section of the town was utterly wiped out. The British Government, the Canadian Government, and private subscription (including large sums from the United States) made up a relief fund of $29,000,000. A special Act of the Canadian Federal Government incorporated the Halifax Relief Commission to administer this fund, and endowed it with unusual powers for expropriating and re-planning land.

Under this Commission the usual procedure following disasters, in which the opportunity to rebuild well has not been utilized, was abandoned. Instead of paying damages to owners of ruined property, the Commission bought or expropriated enough of the ruined area to control its new development, and re-planned and re-built it according to a thorough and comprehensive plan. The old streets had been wastefully and inconveniently laid out according to the usual rectangular plan; some wide avenues ran straight

Maintaining a Busy New York Highway at Small Cost—

WITH its eight miles of Tarvia pavement, the Grand Concourse and Boulevard in New York City is the favorite route of thousands of motorists bound to and from the suburban districts lying north and east of the city. It is free from mud in winter, spring and fall—free from dust in summer—never "sticky"—smooth and firm all the time.

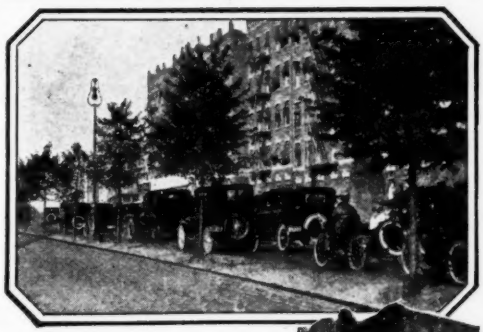
Yet this Tarvia pavement represents a very small investment.

Ten years ago, the old macadam was broken up, resurfaced, and treated with "Tarvia-A," at a total cost of about one dollar per square yard.

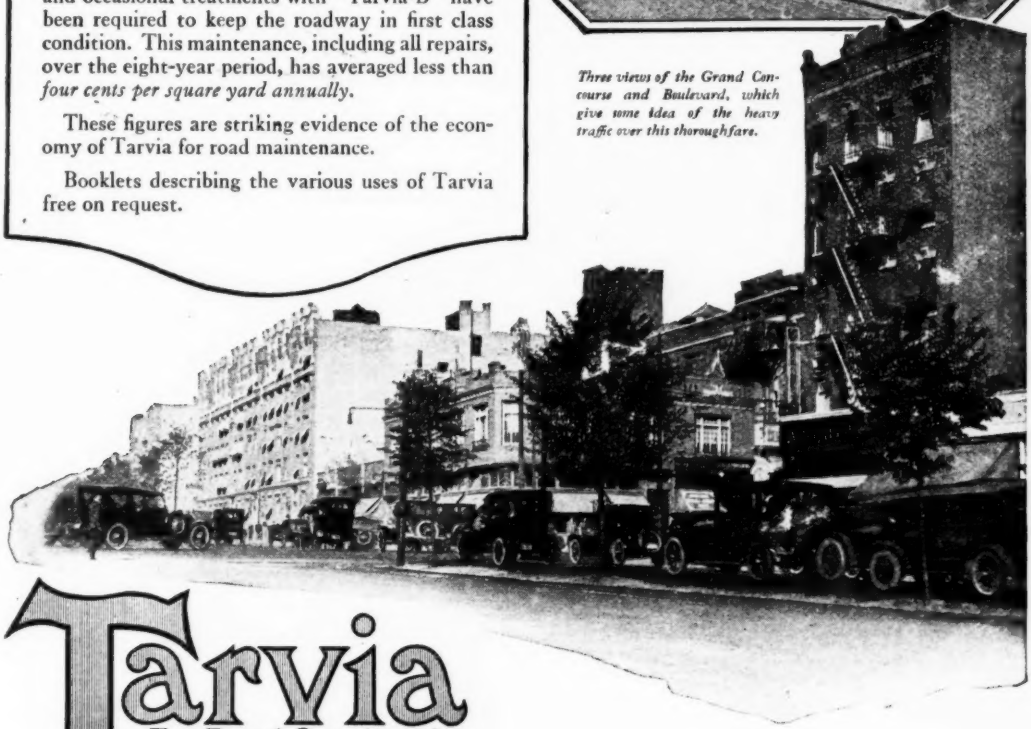
Despite the severe service, only minor repairs and occasional treatments with "Tarvia-B" have been required to keep the roadway in first class condition. This maintenance, including all repairs, over the eight-year period, has averaged less than *four cents per square yard annually.*

These figures are striking evidence of the economy of Tarvia for road maintenance.

Booklets describing the various uses of Tarvia free on request.



Three views of the Grand Concourse and Boulevard, which give some idea of the heavy traffic over this thoroughfare.



Tarvia

For Road Construction Repair and Maintenance

New York Chicago Philadelphia Boston
Detroit New Orleans Birmingham Kansas City
Salt Lake City Seattle Peoria Atlanta
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against grades as high as 20 per cent, and the maximum grades of the nine principal east and west streets were 8, 10, 11, 12, 13, 14, 15, 18 and 20 per cent; the approach to the center of the district was roundabout and over an alternation of flat steep grades; advantage had not been taken of the splendid site overlooking the harbor; and lot subdivisions were standardized without regard to use or the character of the site.

Re-planning is always expensive and wasteful in its re-distribution of values, the price which must be paid for lack of planning in the first place; but on the whole there could scarcely have been a more economical plan for Halifax than the one proposed. Of 508,370 sq. ft. of land included in the new diagonals, central square, etc., 433,140 sq. ft. can be saved in streets, waste land, etc., which may be converted into building land. The balance is but 75,230 sq. ft. No radical change could be made in the old rectangular plan without scrapping expensive local improvements, but with as little violence as possible to the old system, the new system is planned to secure easy circulation of traffic and proper distribution of the density of building; the overwide streets are narrowed and the houses set back; two new diagonals at grades under 5 per cent lead to adjoining regions from the center of the development and converge in a central square around which the principal public buildings are to be erected, and which is an important distribution center for traffic from all directions; a convenient location is made for trolley service; excellent sites are provided for stores and for school houses and other public buildings; the advantages of the town's site are better used by studied situation and orientation of buildings; a fine hill site is reserved for a park; and one district which had been mostly occupied by "shambles" was re-planned for multiple-type workmen's houses.

The design and construction of the buildings was taken up in the same way. Ross and McDonald, of Montreal, architects, devised plans which meet the financial requirements of the development and at the same time afford greater variety, interest, and attractiveness to the district than it formerly possessed. Houses better situated and more attractive than those renting at from $20 to $40 a month in other parts of the city can be had here for from $18 to $25. Part, but by no means all, of this difference has been written off the books of the Relief Commission as excess charges due to the maximum prices at which the work was done. All of the houses will eventually be sold, first choice being given to former residents of the district. Many are built of a not un-attractive compressed concrete block with granite facing and with stucco or frame second stories, as shown in the accompaning view.

The 325 acres along the harbor, being re-built under the direction of the Halifax Relief Commission, are incorporated as part of the city plan now being completed for the remaining 3,960 acres of Halifax, by the Town Planning Board, assisted by Mr. Thomas Adams, Town Planning Advisor of the Dominion Bureau of Conservation. The planning of the region surrounding the city is under direction of the Halifax County Council, which has prepared four schemes to take care of an area totalling 18,138 acres. The rebuilding of Halifax is giving most effective practical demonstration of town planning values. Instead of the uneconomical and commonplace type of development found in most of Halifax, and in most areas rebuilt after catastrophes, the development of this area possesses decided advantages in economy, appearance, and convenience of use. Mr. Wm. E. Tibbs is manager for the Halifax Relief Commission, and Pickens and Roland, of Halifax, are supervising engineers.

A REBUILT AREA IN HALIFAX, NOVA SCOTIA, SHOWING HOUSES OF CONCRETE BLOCK, STUCCO AND FRAME CONSTRUCTION. THIS IS THE NEW COLONY OF WORKMEN'S HOMES.

WATER WORKS SECTION

USING ELECTRICALLY OPERATED VALVES AT BUFFALO, N. Y., AND CAMBRIDGE, MASS.

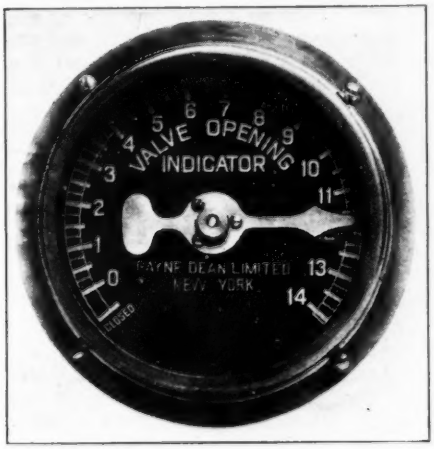
At Buffalo

In 1917, the Bureau of Water, City of Buffalo, under the able superintendence of Mr. George C. Andrews, the present Water Commissioner, started a campaign to reduce water waste consumption with three objects in view:

First. Reduction in operating cost due to decreased pumpage.

Second. Eliminating the necessity of laying new feeder mains, on account of the reduction in consumption.

Third. To reduce the total pumpage to a figure more in keeping with that of other cities, so that a filtration plant could be built at a much less expense than would be necessary if no control were exercised over the waste of water.

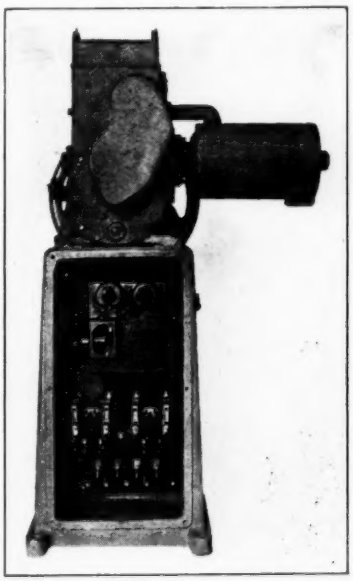


DEAN VALVE GATE POSITION INDICATOR USED FOR INDICATING POSITIONS AT ANY DISTANCE FROM VALVE.

Water is supplied to Buffalo at two pressures, the low, or reservoir service, and high, or direct pumping service.

The low service is connected with the Prospect Reservoir with a capacity of 116 million gals. and supplies approximately one-quarter of the daily consumption.

The five pumps at the Col. Francis G. Ward Station are connected by hydraulically operated valves with two 60-in. discharge mains, one on the low service, and the other on the high service. These discharge mains are in turn connected with 36-in. and 48-in. mains in Front Ave., Seventh St., and Prospect Ave., so that discharge from either 60-in. main can be put on high or low service by operating the necessary valves.



DEAN VALVE CONTROL FLOOR STAND SHOWING CONTROL SWITCHES IN WATERTIGHT COMPARTMENT.

Under ordinary daily operation at the present time it is necessary to operate one of the pumps on the high service in the Massachusetts Ave. Station in order not to overload the 60-in. discharge high service main at the Ward Station. Besides this, ample boiler reserve at the Massachusetts Ave. Station is provided for in order to handle the entire high pumping service in case of emergency. This is done on account of the fact that the Ward Station is dependent upon a single 60-in. main for its high service discharge, and any failure in this line would leave three-fourths of the city of Buffalo gasping for water.

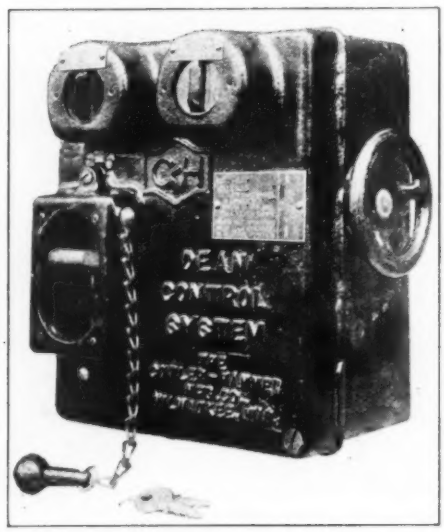
By closing three 48-in. valves, and opening two 36-in. valves it is possible to change the 60-in. discharge main in Jer-

sey Street from low to high service, and utilize it as an auxiliary high pressure discharge main.

By daily operation of these valves it is possible to utilize the Jersey Street main for high pressure service during the hours of peak load, and reduce the discharge materially through the 60-in. discharge main on Porter Ave. In addition, it will allow of the maximum output of 150 million gallons per day being obtained from the Ward Station entirely on the high pressure system.

All peak loads during 80 per cent of the year can be met by the Ward Station alone.

The Massachusetts Ave. Station fires may be banked for 80 per cent of the year, and the coal consumption may be reduced from 10 to 15 tons per day, resulting in a reduction of the operating cost in fuel alone of some $12,000 per year.



DEAN CONTROL STATION INCORPORATING EMERGENCY FEATURE LOCK.

In order to provide these conditions, it would be necessary to either install a new 60-in. main, or operate three 48-in., and two 36-in. valves twice a day, which would require the services of a large number of men, and consume considerable time.

It was finally decided that an attempt would be made to provide some mechanical operating device, so that these valves may be operated by one man, without loss of time, and the Dean Control System, as manufactured by Payne Dean Limited was adopted for the 5 valves in question, and also for 10 similar valves in the Massachusetts Ave. section.

The electrical control system is unique, inasmuch as there are two centralized points of control, one at the Lakeview Ave. Storehouse, completely controlling five valves on Jersey Street and the other control station at the Massachusetts Ave. Gate Keeper's House, controlling the 10 valves in that section.

The problem of adapting a modern control system to old valves also had to be considered, as many of these valves bore no name and no identification mark as to number of turns required to operate.

The application of the Dean System is being made to each valve without in any way shutting down the supply, and during the time of construction the valves may be operated by hand in case of emergency.

The location in which the electrical operating device has to work is anything but desirable, since many of the vaults containing the valves are filled, or partially filled with water, and further, the Dean control units have to withstand the rubbish and water that escape into the vault through the manhole covers. For this reason special attention is given to the design of the units to make them positively waterproof.

On Jersey Street the valves will be operated from a pillar in the street, and adjacent to the valve, and also from the Lakeview Storehouse, each valve then being operated from two points of control. The Massachusetts Ave. valves are all operated from one point.

The cable conveying the current from the switchboard to the valve is all of the highly insulated lead covered steel taped type, buried about 24 ins. below the ground level, and provided with waterproof joints wherever it is connected into the controlling apparatus.

The control units are to operate on current provided by the new turbine units being installed at the Francis G. Ward Station. When this system is in operation it will enable each valve to be closed within ten minutes, by merely touching a lever, providing at the same time indication by means of lights showing whether the valves are open or closed, and on one valve that is used for throttling purposes, an improved Dean Position Indicator is being installed, showing exact position of gate during its full length of travel.

The installation is such that the whole series of valves may be operated within a minute or so of each other, and electrical

closing is accomplished by one man in a few minutes, whereas hand operation would require the best part of a day.

Also, in case of leaks or breaks, the system will be utilized.

At Cambridge

Payne Dean Limited recently completed a rather unique installation for the city of Cambridge, consisting of electrically operating, by means of the Dean System, two 48-in., and one 36-in. distributing valves, controlling the entire system of supply.

If any trouble occurs between this point and the reservoir, or the reservoir should start leaking, the operation of these valves within five minutes would enable water to be pumped directly into the system, instead of to the reservoir.

These valves are underground, in extremely wet pits, and are operated from floor stands placed on concrete foundations.

The system was not the slightest bit disturbed during the installation, and operation was available while the work was being done.

The Control System consists of standard alternating current Dean Units, mounted on floor stands, and provided with vertical shaft, which engages the operating nut of the valve. These stands are provided with mechanical indicators showing the position of the gate, and the control of the valves is at present obtained from the adjacent Weir House. Later, it is proposed to effect control of these valves from the Fresh Pond Pumping Station.

DEAN E 2 CONTROL UNIT ATTACHED TO RENSSELAER 48-IN. WATER VALVE, LOUISVILLE, KY., PUMPING STATION.

Mr. Timothy W. Good, the general superintendent, states that this is only the beginning of the electrification of all their large gates, which they consider one of the most important features of the distributing system, not only for the operation of the valves in case of emergency,

STREET PILLER BOX STAND FOR DEAN CONTROL STATION.

but to keep the valves in operating condition by periodically opening and closing them.

He also states that they are at present equipping four additional gates at the Payson Park Reservoir with Dean Control, contract for which has been let, and that they hope to have most of their large valves so equipped within the near future.

An inspection system has been arranged whereby their engineer and foreman close these gate valves at least once a week.

HOW ST. PAUL WATER DEPARTMENT SAVES $65 PER DAY ON ROUTINE CONSTRUCTION

By J. W. Kelsey, General Superintendent of Water Works, St. Paul, Minn.

We are using 5 Novo engines for various purposes in the St. Paul dater department. One 15 hp. Novo engine is operating an air compressor; another 15 hp. engine is operating a trench backfiller, and a third 15 hp. engine is operating a concrete mixer. The other two are 2 hp.

Novos on pump rigs, used to pump water from trenches when we are laying water mains. The two small ones have been in service 7 years, and it was on the basis of their good performance that we purchased the larger outfits. These have been in use from one to two years.

Drills Through Rock at Rate of 1 Foot Per Minute

We are using the air compressor rig on jobs where we are required to lay water mains and pipes through rock. In many parts of St. Paul the rock lies very close to the surface, so that it is necessary to dig trenches through solid rock, some of which is limestone and some sandstone. In such cases, of course, it is necessary to resort to blasting; and it was to drill the holes for blasting that we purchased the 15 hp. Novo engine operating an air compressor.

This equipment will produce 80 cu. ft. of air at 100 lbs. pressure per minute. Working at capacity, the unit will operate a standard rock drill very easily, with power to spare. In the hardest lime rock the average rate of drilling is about 1 ft. per minute.

2 Men and Outfit Replace 18 Men

Formerly we did this work by hand; but with the air compressor and jack hammer the two men operating this rig replace 18 men doing the work by hand. Such labor is paid for at the rate of $4 to $5 per day. The average is $4.50 per day, making our saving with the outfit $72 per day in labor alone.

The Novo engine is mounted on wheels, making it easy to transport to any part of the city. This is very essential, as our work takes us to different districts. An electric driven compressor would be out of the question, because it is often impossible to plug in on current. In the same way a steam compressor could not be practical because its excessive weight would make it too hard to carry around.

Pipe Laid Through Rock in Winter

A great deal of our pipe laying work in rock is done in the winter time, because it is just as difficult to cut through rocks in the summer as it is in winter. The Novo engine has proved absolutely frostproof; but the compressor rig being water cooled, requires special care in cold weather.

The trench backfiller is used to fill in the trench after the pipes are laid. The outfit consists of the 15 hp. Novo equipped with a double drum, drag line and scraper with a 30-ft. boom. The capacity of the scraper is about 1 yard. On this work the Novo outfit is set up on one side of the trench and the scraper on the other.

Replaces 6 Men and 3 Teams

It is a one-man operated machine, and very flexible in its manipulation, as it is mounted on multipedal tread. As the men say, "It can be turned on a nickel." It is capable of doing the work of about 3 teams with drivers, and 3 additional men necessary to hold the scraper when horses are used. This outfit is capable of backfilling a trench 8 ft. deep and an average of 3 ft. wide at the rate of about 110 ft. per hour. This makes its capacity 2,640 cu. ft. per hour.

When using horses this is very tedious work, and in hot weather both drivers and horses suffer considerably. The Novo makes this work easier for everybody, besides saving us considerable in wages and the hiring of teams. By the use of this equipment we have displaced 3 men and three 2-horse teams with drivers.

Our machines do not work every day, but the compressor averages about 7 full months a year, and the backfiller about 6 full months. The cost of repairs on either outfit does not average over $50 a year. The average life of either machine should be at least 4 years. At the end of that period it will be traded in toward a new one.

Saves $65 Per Day

Figuring wages at $4.50 a day for the operator and $4.50 for the helper, the cost of operating the Novo compressor outfit is $15.29 a day, including $9 a day for wages of the two men required. The engine averages 1¼ gals. of gasoline per hour of operation. As the two men with the compressor outfit do the work of 9 times as many men working by hand, it effects a saving of $65 daily on this kind of work.

The cost of operating the trench backfiller is $14.86 per day, including the wages of the one man required to operate it. As this outfit is replacing 6 men and 3 teams, it is easily saving the department $30 a day over the use of teams. As it handles 2,640 cu. ft. per hour, the operating cost is .07 cents per cu. ft.

Novo engines are very simple of construction, so that a man with any knowledge of gasoline engines can operate them efficiently. We have had very few repairs to make; but when the engine does need attention it is easy to handle. As there are only two castings to a Novo, we can get any part off and on again in a short time. The valves are easily accessible, and the ignition system is so simple that timing it causes little trouble.

ELEVATED REINFORCED CONCRETE WATER TANK REDUCES INSURANCE RATE IN YORKTOWN, TEXAS

By W. L. Simpson, Consulting Engineer, 414 National Bank of Commerce Bldg., San Antonio, Texas

An elevated reinforced concrete water tank with a capacity of 66,000 gals., recently completed in Yorktown, Texas, has reduced the insurance key rate for the town, resulting in reduced insurance rates for every building in that city. This is due to the increased water pressure made possible by the tank.

At the same time that the tank was under construction an extension was made to the 8-in. water supply main and other improvements were made to the water supply system. The entire project, including the elevated tank, cost less than $15,000. This is a small price to pay for a first-class water supply, better fire protection and lower insurance rates. The accompanying illustration is from a photograph taken just after the tank was completed.

REINFORCED CONCRETE 66,000 GAL. TANK AND TOWER AT YORKTOWN, TEXAS.

The foundation for the tower was carried 7 ft. below the ground line. The height of the tower from ground to platform is 79 ft. The tank itself is 21 ft. in diameter and 28 ft. deep, making a total height of 107 ft. The columns are 25 ft. apart at the base and 15½ ft. at the top. The tank platform is 27 ft. in diameter.

The water supply for this system is obtained by pumping from deep wells driven to sand, in which the water rises to within a few feet of the surface. This elevated tank is a new departure in this section of the country. It seems to be an ideal arrangement for a small city and will no doubt lead to similar projects in other communities, as the people of Yorktown consider it a good investment.

The tank and water supply extensions were designed by the writer's firm. The contractor was Henry Schoenfeld, of San Antonio, Texas.

THE USES OF LIME IN WATER PURIFICATION

By C. Arthur Brown, Chief Engineer, Engineering Bureau—Water Purification, American Steel & Wire Co., New York, N. Y.

Approximately, there are 1,015 filter plants in the United States and 114 in Canada, purifying municipal water supplies. There are about 40 plants in the U. S. using chemical coagulation without filtration, the number in Canada being unknown.

Approximately, the tonnage of caustic lime used for this purpose in the U. S. is 55,000 tons per annum. This is absorbed by about 120 plants.

Using the same ratio and assuming 30 per cent of our municipal systems might be induced to use this material, the tonnage of caustic lime would be 185,000 tons per annum.

Assuming 40 per cent of these plants using lime, the consumption would amount to 247,000 tons per annum.

A rather careful survey of the possibilities would seem to indicate that between 30 and 40 per cent of the water purification systems in this country might use lime advantageously.

If we assume the growth in the building of water purification plants to follow the curve of the last ten years, the consumption in 1931 might reach a total of 346,000 tons per annum, which is the maximum which we reasonably could hope to attain.

It should be remembered that the use of lime for this purpose does not date back many years. The first complete softening plant for municipal use was designed by the speaker in 1902 for Oberlin, Ohio.

Advantages and Disadvantages of Iron and Lime Process

In this connection, the advantages and disadvantages to be expected from the use of the iron and lime process of water purification play a very important part. That advantages and disadvantages do exist cannot be disputed but, with the proper use of the process, the advantages are greater than the disadvantages, even to a greater extent than is believed generally.

There are some waters with which this process is not well adapted to produce the most satisfactory results, but this holds true of all other processes of water purification. Where the process can be used to advantage, the type of water being adapted to its use, the benefits to be derived are as follows:

Advantages

Any chemical method using two chemicals will be more flexible and will meet more different conditions than a similar process using only one chemical. Thus, in the use of this process, it is feasible to meet more varying conditions and produce a result in the purified water which will vary within wider limits than if we were trying to use a coagulant alone.

If it be desirable to soften the water, this can be done, while if it be desired to leave the water with the same degree of hardness as it naturally carried, this likewise can be done, or if it be thought advisable partially to soften, this procedure can be made effective. If the raw water be very turbid, it is usually possible to use a larger amount of lime and save on the more expensive coagulant, sulphate of iron. If the conditions are such that considerable quantities of lime cannot be used without other difficulties, it is feasible to use more iron sulphate and secure proper results in this manner.

A soft water is more desirable than a hard water for most commercial and all domestic uses. The ability to soften or partially soften a water by the use of this process is very desirable. Some of the advantages of soft water may be mentioned:

Advantages of Soft Water

In many chemical processes, a soft water is very advantageous. For steam generation it is much to be preferred. For laundry purposes a soft water is very economical, saving much soap. It is much more economical to use for tea and coffee. Vegetables, cereals, and meats cooked in soft water are more nutritious and of better taste than those cooked in hard water.

The life of linen, cotton, silk, and woolen goods is largely prolonged by washing them in a soft water, rather than in hard water.

Where two materials of different vibratory rate are brought into close contact, the difference in the vibratory rate of the two tend towards the fatigue of both. Thus, if a mineral matter having a low vibratory rate is brought into intimate contact with a vegetable fiber possessing a higher rate of vibration, the conflict in the vibratory rates of the two has a tendency to fatigue and wear out both of the materials.

If a vegetable fiber is brought into intimate contact with an animal fiber, the lower rate of vibration of the vegetable fiber reacts unfavorably on both, tending to fatigue both.

Where a hard water is used to cleanse these fibers, mineral matter is deposited on and in the fibers, the result being that the lower rate of vibration of the mineral matter tends to fatigue and destroy the fibers. This matter might be gone into at greater length but space will not permit.

The effects of very hard water upon the human economy, when used as a beverage, is less satisfactory than where a reasonably soft water is used for drinking. Many of the so-called chronic ailments of the human system, such as gall stones, rheumatism, kidney troubles, stiffness of joints or muscles and some forms of auto-intoxication are benefited by the use of a soft water, particularly if it be used freely.

When the Public Demands Soft Water

A proper presentation of these facts would have a tendency to cause the public to demand the softening of hard waters. Public officials in charge of water plants are as amenable to public demand as other public officials, but the demand must be made before they can be expected to act.

It costs more to build a plant that will soften a water supply than it does to built a plant that will filter the water without softening it. It costs more to operate the softening plant than it does to operate the plant which filters but does not soften. The public should expect and can well afford to pay a cent or two more per thousand gallons for a soft water than for a hard water, and they must be educated to this point before we can expect our public officials who are entrusted

with the construction and operation of these plants to become enthusiastic over water-softening.

It is well to remember that experience is the best teacher. In cities where softening plants have been built and the citizens have become accustomed to the use of the softened water, the public official who attempted to abandon softening would find himself out of a job in a remarkably short period of time and his successor would be very loth to attempt the same thing, regardless of the expense of operation and maintenance.

The reaction of lime with the hardening compounds in the natural water is rather slow. It can be materially hastened by providing the plant with a properly designed mixing chamber. Some of the trouble can be avoided by building the settling basins with a larger capacity than where softening is not attempted but even after all these things, we must still expect some after effects to be found.

Objctions Hampering Softening Process Extension

These objections may be sufficient to prevent many cities from building softening plants or plants to use lime without material softening, but they have not proved of sufficient force to stop softening in plants where the citizens have become familiar with the advantages of the softened water and until such time, we must regard them as being more largely theoretical than practical.

One of the greatest, if not the greatest difficulty we have encountered in inducing cities to adopt the use of lime for these purposes is to be found in the design of plants to use the process. Usually, the engineer having charge of design must take into consideration the amount of money available to build the plant.

Generally speaking, the money provided is not adequate to permit the engineer to do all the things he deems necessary or advisable. As it costs more to build a plant to use lime properly than one not intending to use lime at all, his natural tendency is to build the cheaper plant and use the money he saves in this way to do some of the other things he wants to do.

Ordinarily, the engineer is the court of last resort and the city is guided entirely by his judgment. If he is opposed to the use of lime, it is rather difficult to induce him to change his mind and practically impossible to have the plans provide for the use of this material unless he can be shown the advisability of so doing, and this is not always the easiest thing imaginable.

Engineers are not very prone to listen to laymen who attempt to discuss engineering problems any more than a doctor is likely to give assiduous attention to a layman attempting to tell him how to care for a patient.

A Bureau Rendering Valuable Free Service to Engineers and Cities

Realizing this fact, our company established its Engineering Bureau—Water Purification, about 18 years ago. The function of this bureau is to keep a little ahead of the times, if possible, particularly in lines relating to the use of sulphate of iron and caustic lime in water purification work, and to be in a position to advise and consult with interested parties in the use of the process.

The services of this bureau are free to any engineer, city, or corporation having any water purification problems, regardless of the nature of such problems. Our instructions are to tell the truth, no matter whom it hurts or benefits. Where iron and lime can be used to better advantage than anything else, we are instructed to say so and prove it if given a chance but where we think some other material will do better work or give more satisfaction, we are instructed to say so quite as frankly.

The speaker has been the chief engineer of this bureau since its inception and has repeatedly advised against using sulphate of iron in cases where he deemed it less suited for the needs of particular cases than other competing material.

Even in cases where we are entirely satisfied that our process is the best for a particular case, we cannot always convince the engineer in charge of design of this fact, but we can frequently show him savings, short cuts, new methods, and in various other ways be of service to him. Sometimes these bring results later on at some other point.

Furthermore, in investigating plant conditions and operation, the faults of design become more or less apparent, and sometimes we are enabled to find solutions for difficulties that have proven beneficial in the design of later plants. Some of the advances in the art of water purification, in the betterment of equipment, and in the avoiding of troubles are traceable directly to this bureau.

The foregoing matter is from a paper presented by Mr. Brown before the annual convention of the National Lime Association, held in New York City, on June 15, 1921.

PREPARED JOINT 2 IN. CAST IRON PIPE

The development of Prepared Joint by the Research Department of the American Cast Iron Pipe Co., Birmingham, Ala., has enabled that company to put on the market a 2-in. cast iron pipe. Thus the more durable cast iron can now be used in many cases where black and galvanized pipe have been used in the past.

Prepared Joint

"Prepared Joint" is factory-made. To complete a joint in the trench it is necessary only to insert a plain-end into a hub and calk the lead. In the trench there is no yarning or pouring of lead. The joint materials are placed in the hub

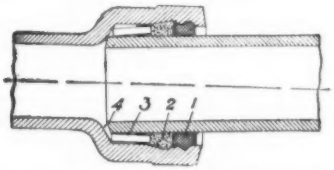


FIG. 1—DIAGRAM SHOWING ELEMENTS OF PREPARED JOINT FOR 2-IN. CAST IRON PIPE.
1, Lead; 2, Hemp; 3, Wedges; 4, Inclined Shoulder.

under such conditions at the factory that they are uniform. It does away with lead melting apparatus along the trench and eliminates the trouble incident to pouring hot lead joints in wet ground. The speed with which it is calked in a trench reduces cost of labor.

This joint has been supplied in sizes up to 12-in. for several years. It is made at the factory by standing the hub in a vertical position and inserting the joint materials, which includes a band of iron wedges and proper amounts of hemp and molten lead. The joint materials are left uncalked and are protected in shipment by a wooden plug so constructed that it can be removed easily in the field by a bar or piece of wrought pipe inserted through the spigot end. Because the mandrel over which the joint was made at the factory is slightly larger in diameter, the spigot end of a pipe is easily inserted into the Prepared Joint, which then is calked in the same way as the old-fashioned trench-poured lead joint. This joint automatically tightens under deflection. Ability to deflect without leaking or breaking is especially important in smaller sized pipe. In this pipe the inside shoulder of the bell is beveled as shown at 4, Fig. 1. When the joint is first calked the iron wedges slide down this beveled shoulder, or incline, until they engage the spigot end of the next pipe all around. Then each wedge is a small anvil against which the calking is perfected. In case of deflection after being laid, as so often is the case under street traffic and in made earth, the extreme end of the pipe goes down and carries with it at the bottom the wedges (3), which are brought forward as they move along the inclined shoulder (4), forcing the hemp (2) and lead (1) into further compression and thus automatically tightening the joint as deflection takes place.

The Two Inch Pipe

This pipe is 5 ft. in laying length, weighs 5 lbs. per lin. ft., and is tested to 300 lbs. hydrostatic pressure. It is guaranteed to withstand 150 lbs. working pressure. The short length of this pipe is a decided advantage in handling, in adaptability to the contour of the ground, and flexibility with consequent proof against breakage.

With this pipe, standard 2-in. screwed fittings are used and it will connect up with standard threaded 2-in. pipe. Moreover, it can be tapped for standard ½-in. service connections; for larger connections a standard saddle or fitting should be used. Four kinds of this pipe are furnished as wanted:

1. Hub and spigot.
2. Double-hub.
3. Double thread.
4. Repair hub.

A leaking section of 2-in. black or galvanized pipe is replaced with 2-in. cast iron pipe in the following manner:

First—Cut a short piece of thread and spigot pipe 6 to 12 ins. in length from a

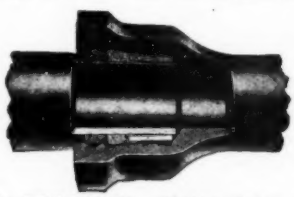


FIG. 2—PREPARED JOINT 2-IN. CAST IRON PIPE CUT OPEN TO SHOW POSITION OF JOINT MATERIALS.

double threaded pipe. Screw this short piece into a coupling to make the connection.

Second—Calk a double-hub pipe on to this, which gives the line a hub leading.

Third—Calk hub and spigot lengths on to this continuously until a fitting is wanted.

Fourth—If a fitting is desired, connect

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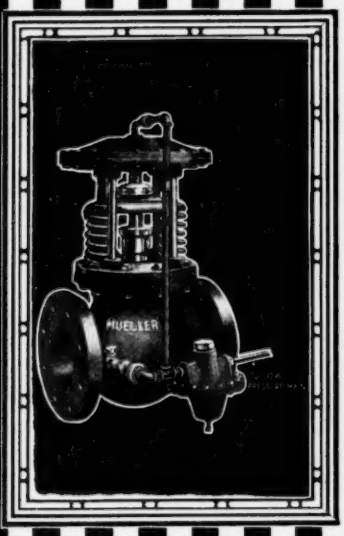

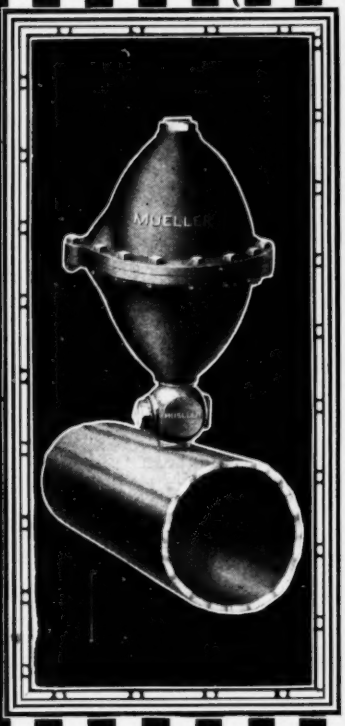

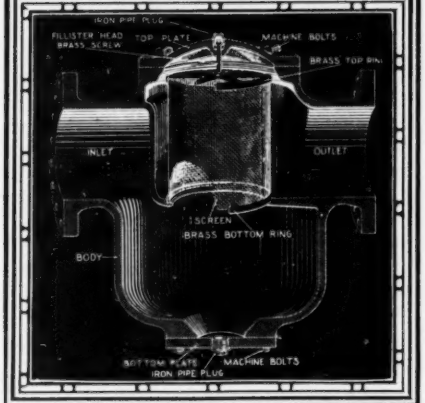

to it with all or a part of the thread and spigot piece left from the first cutting. Get away from the fitting with a piece of spigot and thread and a double-hub.

Fifth—To connect with threaded pipe again, use a piece of spigot and threaded pipe of the proper length.

If this pipe is laid on 4-in. blocks no bell holes are necessary. After a section is completed start at the beginning, taking the blocks out consecutively and letting the pipe down with as little disturbance of joints as possible. Or it is entirely feasible to put together three to five lengths at a time on top of the ditch, calking one side and then rolling them over and calking the other side, then lowering the section into the ditch, calking in the ditch every third to fifth joint. It is preferable to dig a bell-hole with this method of laying instead of using blocks in the ditch as before mentioned.

Each pipe is octagon shaped at the base of the bell. This enables the pipe to be twisted either with a wrench or chain-tongs when it is taken up.

The repair hub makes repairs and cutting-in possible with a minimum of labor, because it has a telescoping effect. The section of pipe to be removed is broken out. The repair hub is telescoped over the spigot end in the ditch until its spigot will enter the other hub. Both hubs are then calked in the usual way.

THE TREND OF READJUSTMENT IN THE WATER WORKS FIELD

By Robert E. McDonnell, Consulting Engineer, Interstate Bldg., Kansas City, Mo.

A good water works official doesn't put off his purification improvements until an epidemic is on, and the rehabilitation of his pumping equipment should not follow a fire, but should be a preventive of the fire and take the lead. Too many water works improvements follow instead of lead. So many follow the growth of towns when they should really precede the growth and anticipate the requirements. A city is no bigger than its water works plant.

Water plants all over the United States have suffered a severe set-back owing to the war; the failure of the water plant to improve has retarded other improvements. Several cities, to my own personal knowledge, now have immense paving and building programs that must await the laying of new water mains and larger feeders.

Things Learned During the War

A famous surgeon recently remarked that the medical and surgical discoveries developed by the war would later save more lives than were lost in the war. The higher standards and improved efficiency in water works installations and operation since the war have been remarkable. We learned the value of co-operation and the value and use of propaganda before the public to call attention to our water works needs. We learned the use of emergency treatment and sterilization plants and found that for temporary use a very bad water can be freed from bacteria. The scarcity of help in war times turned our attention to the use of all kinds of labor and office saving appliances. The handling of accounts in water offices has changed from a bookkeeping job to a job for a mechanical operator who now turns out water bills for ten customers in the time required for one by the old methods. The placing of the water departments on a cash basis for purchasing supplies has become almost universal. The high cost of fuels brought engineers and operators to using equipment with the least consumption of fuel. The economy of operation in pumping equipment has more weight with eight and ten dollar coal than in pre-war days with two and three dollar coal.

Eliminating Waste

The Government preached economy and elimination of waste until water waste surveys are being made with excellent results. A smaller water consumption per capita is the goal of many superintendents. The installation of meters to measure water used and check the needless waste has saved many a water department from ruin. Pure water is too precious a commodity to deliver to a customer without some check on how much he gets. The city with a universal meter system and a station meter for checking water pumped with water sold was a few years ago a rarity, and is now quite common. We have also found that service to the public is the only kind of politics necessary to play in order to hold the job.

Pure Water

Regardless of whose fault it is, the water official who permits impure water to get to the customers, whether by accident or otherwise, is going to have rough going. He will have customers telephoning, State Boards of Health telegraphing, American Public Health Service visiting

Before You Lay the Pipe You Must Dig the Ditch

Afterwards, if the pipe is perfect, the work and expense end. But if the pipe is defective, you must dig the ditch again, greatly increasing the labor cost to say nothing of interrupted service and other annoyance.

Pipe Insurance is one of the things you buy when you invest in cast iron. The records in Europe and America tell how long it has lasted; but no record as yet tells how long it will last. When you buy cast iron, therefore, you buy just once—pipe, ditch, freight and labor. Isn't it worth remembering?

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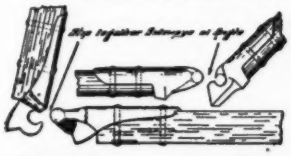

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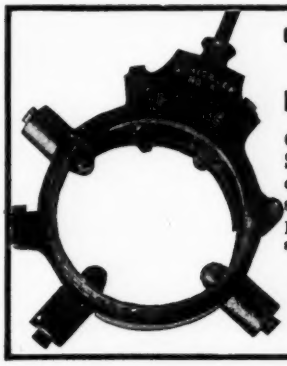

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Figures Look Smaller Now

So many big things were done in a big way during war times that we have raised our ideas as to capacities, sizes and costs. A bond issue that formerly staggered a community is put through now without hesitation. These bond issues are now needed in hundreds of towns. Water improvements were so long deferred that water plants are underbuilt and behind in their building programs.

Burden of High Freight Rates

In the twenty-five years' experience of the writer in the water works business he has never seen such an urgent need of water improvements; yet there is a hesitation and a marking of time, due largely to the desire for lower prices, a better bond market and a decline in freight rates. When the freight on a ton of water works materials almost equals the cost of the materials themselves it is becoming a burden that hampers progress.

A short time ago implement dealers were selling farm implements at high prices and farmers bought them when reminded that very few bushels of wheat or corn were needed to pay the price, but now the farmers come back with their own argument, offering the same number of bushels for the implements. The farmer's argument hits machinery dealers with the same argument used by the dealer a year ago. In the water works materials the prices have not all declined to a level with the prices charged for water. Water departments everywhere are in need of better prices for their water, for the present prices are out of line when compared to the cost of materials and labor needed to rehabilitate the plants.

Water Rates Too Low

Pure water and higher standards of service are being demanded constantly and yet water rates have remained almost stationary. Many officials fool themselves into believing their cost of pumping and delivering water is lower than it really is. Recent investigations by the writer for a city showed water being delivered to large users at less than its cost and one railroad official boasted of the fact that his company had, in many cities, been getting water at less than its cost. This causes trouble when the time comes to replace pumps and to rehabilitate the plant. It behooves every water official to take stock within himself, analyze his operating costs, interest on his bonds, sinking fund depreciation and see what rates should be applied, especially to large users, who too often enjoy water rates ruinously low.

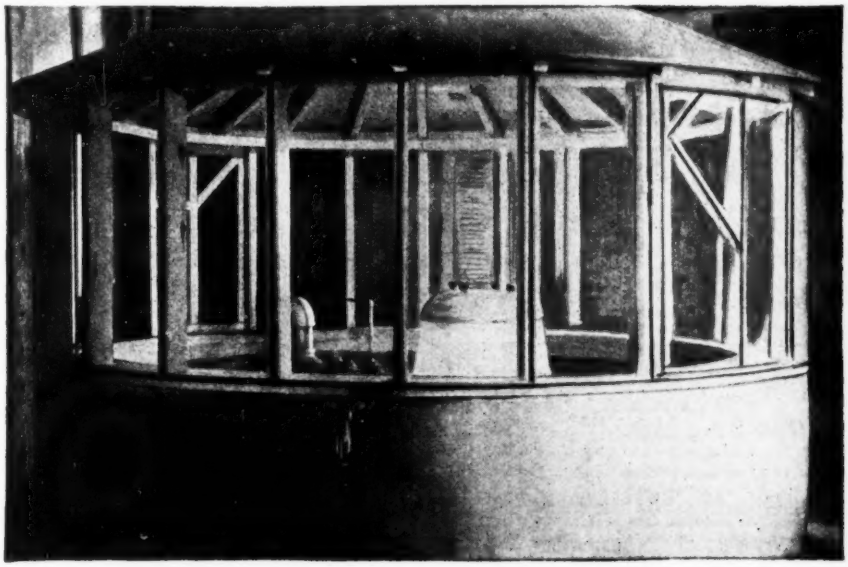
The foregoing discussion is from the presidential address delivered by Mr. McDonnell at the recent annual convention of the Southwest Water Works Association.

A STRAIGHT DYNAMITE PROOF AGAINST FREEZING IN ZERO TEMPERATURES

The Du Pont Company has developed and perfected a formula for the manufacture of straight dynamite which results in that explosive being proof against freezing even in zero temperatures. As a consequence of this development the company has determined to discontinue the manufacture of its former straight dynamite and hereafter all this kind of explosive will be made by the new low-freezing method. The perfection of the formula is the result of years of experimentation in the laboratory and in the field and marks one of the greatest advances in the art of explosives manufacture. Straight dynamite has for years been the standard of the world in nearly every kind of open work, but a disadvantage has been its liability to freeze at temperatures below 50 deg. Fahr. As any dynamite loses some part, if not all, of its efficiency when chilled or frozen, many attempts have been made to make it low-freezing. The perfection of the new "powder" by the Du Pont Company makes it possible to use straight dynamite the year round in industrial operations. Thawing, with its loss of time and attendant dangers, has practically been eliminated. The new explosive has been fully tested and proved and the formula for making it has been made standard in all the plants of the company producing dynamite.

MUNICIPAL BOND MARKET

Following an active demand and a sharp rise in market values in July and the early part of August, bond business was very dull in the latter part of August. There was no indication of any weakness, however, and the month closed with prices firm and the floating supply of bonds notably small, says *The Bond Buyer*.



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Construction News and Equipment

ADVANTAGES OF PORTABLE EQUIPMENT FOR GRAVEL PIT WORK

By H. P. Sigwalt of the T. L. Smith Co., Milwaukee, Wis.

In many states there are small and medium sized deposits of sand and gravel which have not been worked by producers because it does not pay to install an expensive stationary plant for the amount of aggregate available.

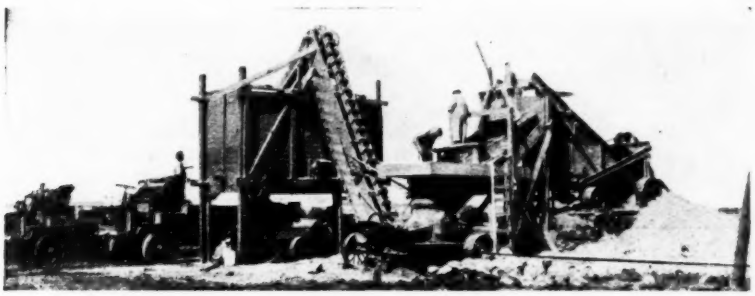
Contractors sometimes find small deposits of excellent aggregate in the immediate vicinity of construction work they have in hand, but because of the expense connected with producing sand and gravel, these contractors feel that they cannot afford to work out these deposits, so they purchase their materials from some distant producer who operates a big pit—usually so far from the job that rail transportation is necessary.

Work in Green Lake County, Wis.

These methods are adding to the cost of construction in general. Contractors who are trying to get down to "bed rock" costs will undoubtedly find some interesting suggestions in the following description of the portable gravel pit plants developed by the Bridge and Highway Commission of Green Lake County, Wis.

The problem in Green Lake County was to utilize the gravel deposits in the county without investing a great deal of money for equipment. The deposits ran small and occurred at several points along a stretch of 26 miles of road which is part of the county's new road program. By utilizing several of these deposits as the road work progressed, it was apparent that a lot of hauling expense could be avoided.

In his investigations of suitable equipment, Commissioner D. C. Williams saw the possibilities of combining a portable rock crusher with the portable Smith Excavator and Loader. Plans were drawn up which suited the county's requirements perfectly and it was found that a complete plant of this type could be installed at very little expense. The whole plant was comprised of one Minneapolis Steam Tractor, 20 H. P., one Allis-Chalmers Portable Gyratory Crusher, one bucket elevator, one Smith Excavator and Loader, two small material bins (total capacity 20 yds.), and screens.



ARRANGEMENT OF EXCAVATOR AND PORTABLE ROCK CRUSHER AT GREEN LAKE COUNTY GRAVEL PLANT AT MANCHESTER, WIS.

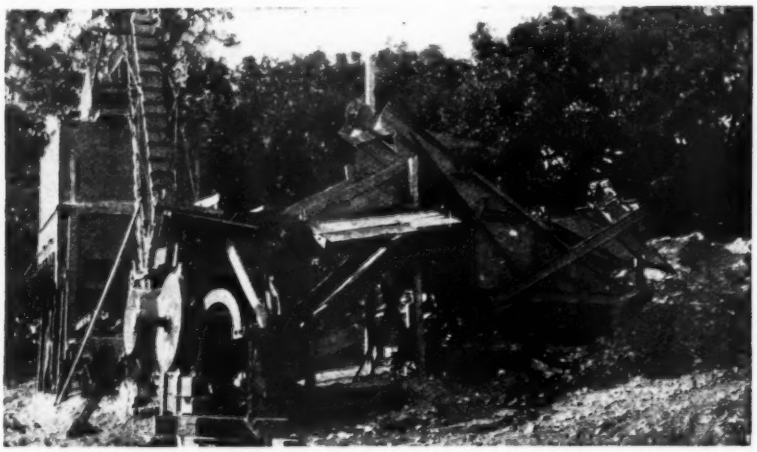
The first plant was installed near Manchester, Wis., at an excellent deposit of gravel that needed no screening. Three to five trucks—quads and four wheel drives, army issue—were available. This was not sufficient to handle the capacity of the plant but average daily production ran between 125 and 137 cu. yds.

A Second Plant Installed

The first plant proved so satisfactory that another plant was installed, practically a duplicate of the first, at Dalton, Wis., about 7 -miles from Manchester. With these two plants a long stretch of road was handled and the truck-haul was cut down very materially.

About 10,000 yds. of sand and gravel were taken out at Manchester and then

the complete plant was moved to another pit closer to the work in hand. At Dalton the first pit yielded about 4,000 yds.; then the whole plant was easily moved about 100 yds to another excellent deposit containing approximately 10,000 yds. Moves of this sort would have been prohibitively expensive, if possible at all, with any equipment less portable than that employed.



ARRANGEMENT OF GRAVEL PLANT AT DALTON, WIS.

Plant Layouts

The pictures show plainly how the plants are set up. The excavator and loader is placed at the edge of the gravel deposit, mounted about 4 ft. off the ground. It digs within a 150-ft. radius. The rock crusher is placed so that the excavator loads directly into it. A bucket-conveyor elevator carries the crushed stone and sand as it is discharged from the crusher, up into the material bins. From the bins the trucks are loaded.

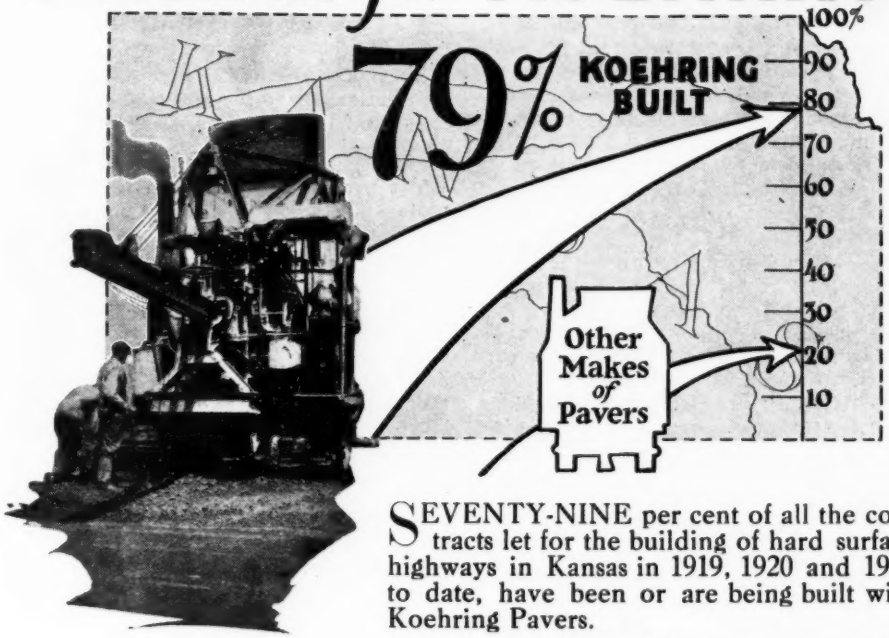
The Smith Excavator and Loader is operated under its own power—18 H. P. gasoline engine. The rock crusher and bucket-conveyor are operated by the steam tractor.

All the labor required on a plant of this type is one foreman, one excavator operator, one crusher man, one tractor operator, one man at the loading bins, two or three men in the pit—7 or 8 men with a plant capacity of about 200 yds. per day.

ABOUT 10,000 CU. YDS. OF GRAVEL HAVE BEEN REMOVED FROM THIS MANCHESTER, WIS., PIT WITHOUT MOVING THE EXCAVATOR.

Several other Wisconsin and Minnesota counties, doing their own road mainte-

Kansas *for* KOEHRING



SEVENTY-NINE per cent of all the contracts let for the building of hard surface highways in Kansas in 1919, 1920 and 1921 to date, have been or are being built with Koehring Pavers.

Such an almost universal choice by Kansas contractors speaks more eloquently of the value and worthiness of Koehring Pavers than pages of advertising could possibly do. Here are the statistics:

Total number miles concrete road let to date in Kansas	181.349
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Total mileage of hard surfaced roads let	241.392
Mileage paved or being paved with Koehring machines	191.309
Mileage paved or being paved with all other machines	50.083
Percentage of Koehring Paved roads	79.249
Percentage of roads paved with all other machines	20.752

Of the 181.349 miles of concrete roads let, 137.224 miles, or 75.668% are Koehring built roads. And of the 60043 miles of brick roads let, 54.085 miles, or 90.077% are constructed with Koehring pavers.

The customer is the final judge of worth. And 79% of the state hard road builders of Kansas back their judgment that the Koehring Heavy Duty paver is the paver of absolute dependability.

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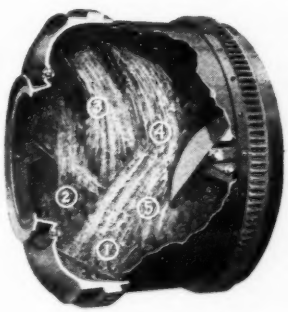

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nance work, have employed the Smith Excavator and Loader to excellent advantage in gravel pits.

Advantages of Portable Equipment

Producers who have adopted the Smith Excavator and Loader on gravel pit work find its advantages sum up as follows:

It requires only a small investment.

The operating cost is low, because of minimum labor expense.

The equipment is out of the pit at all times.

The wagons or trucks are loaded at the surface, not down in the pit.

The plant is portable; when the pit is abandoned, the equipment can be moved easily to another deposit.

Because of portability, plants can be located close to work in hand, thus cutting down the distance of haul.

Small deposits, which it would not pay to work in any other manner, can be profitably excavated by this method.

The excavator does its own stripping. It is equipped to plow, dig, haul and load any type of soil. With other gravel plants, a steam shovel or some other equipment must be used first to strip the overburden.

If conditions demand big production, two or more excavators can be set up so as to load into the same crusher.

Under existing conditions, with freight rates so high on sand, gravel and stone, it is particularly advisable to utilize those deposits closest to each job and the above method suggests an economical and practical method, with trucking haul reduced to a minimum.

CHANGING STONE QUARRY FROM HAND TO STEAM SHOVEL METHODS

By Irving Warner, General Plant Manager, Charles Warner Co., Wilmington, Del.

During the extremely difficult operating period of the war and immediately thereafter many a quarry operator turned his attention to the question of eliminating hand work and substituting the steam shovel. Now that the pressure of labor shortage is removed, many operators are no longer considering this expense, although others realize that sooner or later the laborious work of sledging and loading stone must give way to machine methods.

The purpose of this paper is to discuss the various local conditions and their effect upon the choice of proper equipment.

The particular problems may be summarized as follows:

1. The Quarry.
   a. Nature of the stone.
   b. Height of the quarry face.
2. Size and type of shovel.
3. Transportation system.
4. Crusher.

Each of these items must be taken in its relationship to the others and, at best, any solution is a compromise.

The Quarry

The nature of the stone has a most important effect upon the size of the crusher. A strong-bodied stone of high crushing strength and few cross fractures requires a crusher with a larger opening than a softer, more friable rock, irrespective of the size of shovel and cars. In fact, this question of the strength of the rock may be the determining factor in the selection of a crusher of sufficient size.

Near Bellevue, Ohio, the France Stone Company has a deposit of stone which is quite filled with cross fractures. This stone blasts down easily and is handled by a railway type steam shovel with a dipper of about 2½ or 3 yd. size. This material is dumped into a No. 9 gyratory crusher and requires very little hand feeding. This plant affords an extreme example of the satisfactory combination of a large shovel and small crusher which is possible through the nature of the rock. A No. 9 crusher has an opening between the head and the concaves of 18 ins.

At the plant of the Charles Warner Company at Cedar Hollow, Pennsylvania, a reverse condition has been experienced. Some of this rock has very high crushing strength and blasts out in large diamond shape pieces. At this plant ¾ yd. traction shovels are used, yet it was quite easy to handle pieces which will arch and choke in a jaw crusher having a 48x60 in. opening.

No one should consider changing over his quarry from hand methods to steam shovel without making a thorough examination of the practice and equipment at various plants. And when such a survey is made it is necessary to give most careful attention to the character of the rock in the quarry where the changes are contemplated. It is one of the most important phases of successful installations, and is the one most likely to be overlooked.

The height of the quarry face has a bearing more on the methods of quarrying employed than on the equipment of shovels and crushers. It does have an effect upon the proper drilling equipment.

A face of less than 40 ft. is preferable

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for any size of shovel. A certain standard practice has been developed in the large fluxing stone quarries between New Castle, Pennsylvania, and Youngstown, Ohio. These quarries are all operating on horizontal strata. In some cases the height of the face will be 15 ft., in a few cases as low as 7, and sometimes as high as 22 ft. The shovels used are the railway type handling dippers from 2½ to 4 yds. Drilling is done on the top and at such distance back from the face that these large shovels can clean up the entire shot on one passage. Since the quarry face is of a uniform curvature the development of the quarry consists of a gradual spiraling out which brings a very high efficiency of operation.

In higher faces, or with the use of smaller shovels, it becomes necessary to make two or more trips past the front of the blast in order to make a complete clean-up of the loose rock. There are some objections to this system, as it is likely to make the production of the shovel inconsistent. In some cases the shovel will produce more on the first trip when working on loose stone and in other cases it will make better time on the latter trips, when it has a greater body of stone to work against. Difficulties in this connection can often be overcome by proper quarry management. By blasting against a shot that is already out, it is often possible to maintain a loose condition of rock which facilitates the work of the shovel and at the same time maintain a considerable depth of broken rock so that the shovel always has plenty of material to work upon.

The higher the face the greater is the tendency for the stone to come out insufficiently shattered. This becomes a very serious problem with stone which has a natural tendency to come out in large pieces. Therefore it is not desirable to drill the holes back at a considerable distance from the front, as this condition would thereby be aggravated.

This problem has been appreciated at one of the quarrying operations near Youngstown, Ohio, where the churn drill has been abandoned and rows of tripod drill holes are put down from on top. More frequent spacing of these smaller holes results in a more thorough breaking up in the primary blast, largely obviating delays for block holing.

Steam Shovel

Undoubtedly the best size and type of steam shovel for quarrying purposes is the railway shovel running on a track and mounted on eight wheels, with a dipper capacity of about 3 yds. These shovels are rugged, of a standard type and should be used if other conditions around the plant permit.

Such a shovel with good quarry management can deliver from 1200 to 1500 tons of stone a day. Accordingly, it would scarcely be wise to use a shovel of this size unless at least 800 tons daily were desired. It might also be undesirable to have a plant entirely dependent upon one shovel for its supply of stone provided there were no facilities for storage. This would be a question that every operator would have to settle for himself, namely, whether he would be willing to take the chances of being tied up through the breaking down of a single shovel or whether he would take the increased operating costs of having an extra shovel or by using smaller equipment.

It scarcely pays to use a railroad shovel of less than 2½ yds. capacity. With the smaller sizes, the shovel becomes slow in moving heavy stuff and it is not flexible enough to get out of the way for heavy shooting. In addition the cost of laying the tracks for the shovel and for the paralleling line of industrial track would be no greater for the big shovel than it would be for a smaller one.

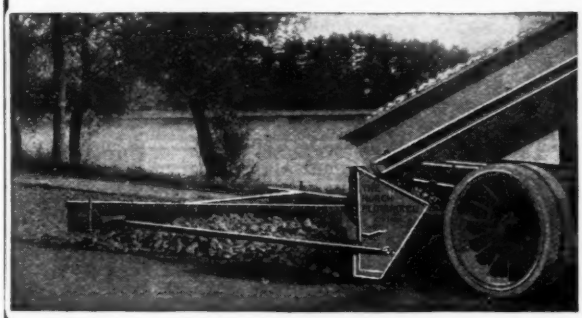
Smaller shovels have been used only to a comparatively limited extent in quarries. Yet in the few installations there seems to be a concensus of opinion to step down to shovels of the traction type of 1 yd. capacity or less.

It is not usually feasible to use a shovel on traction wheels of a size greater than 1 yd. In some quarries this has been done where there is very little dirt in the stone, so that the quarry floor offers a very good roadway for a heavier shovel. The ¾ yd. shovel on traction wheels will weigh approximately 20 tons, and in general this is heavy enough load on any ordinary quarry floor.

Under good local conditions a ¾ yd. shovel can do about 300 tons daily. A crew of two men is sufficient unless the quarry floor is allowed to become irregular.

Well built small shovels can handle stone larger than a 48x60 in. jaw crusher can receive, so that in general no problem of additional block holing is introduced through the use of these smaller machines. The objection to their use lies in the fact that in heavy work they become quite slow, comparatively more so than a heavier shovel.

Small shovels on traction wheels offer attractive possibilities to a quarry opera-



BURCH STONE SPREADER

Here is the greatest time and money saver ever devised for the road contractor.

It is a simply operated attachment for trucks which spreads the stone to any desired depth and width as it is unloaded. The **Burch Stone Spreader** permits you to use the exact amount of stone needed, thus eliminating rehauling and the expense of hiring stone spreaders.

All requirements on the road are provided for in adjustments which are made in only a few minutes.

Complete information regarding this Spreader will be mailed upon request.

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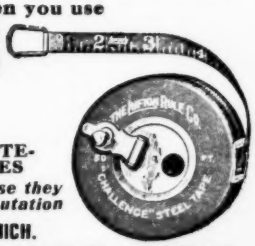

PIONEERS IN CONNECTION WITH THE NOTE-WORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation

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tor under the following local conditions:

1. A small tonnage say, less than 800 tons per day.
2. Where it is desired to split up the tonnage into smaller units either for reliability of stone supply or because of the nature of the rock that must be taken out from the different points in the quarry.
3. When an industrial system is of light weight which would prohibit the use of a heavy shovel.
4. When the conformation of the quarry prohibits the rounding out of the quarry in a uniform curve so that the railway shovel cannot be advantageously employed.
5. Where the floor is firm so as to give good roadway for a shovel on traction wheels.

From the present outlook there would appear to be no field between the small traction shovels and the large railway shovels. Therefore the investigator is practically limited to these two extremes of installation. With the perfecting and cheapening of the caterpillar tread, there may be a future for the full revolving shovel of about 1½-yard capacity. It is to be noted, however, that a full revolving shovel of large size must necessarily be sluggish as compared with the railway type shovel which moves only its boom.

Transportation System

The following points regarding a transportation system must be taken into consideration.

1. Relative size of car and shovel.
2. Size of the unit of train movement.
3. Relative size of car and crusher.

When using heavy railway type shovels, the gauge of the industrial track should not be less than 42 ins. and standard gauge of 4 ft. 8¼ ins. is preferable. With standard gauge, it is possible to use a heavy, well-designed car that will hold as much as 15 tons which is very instrumental in rapid operation.

A point not usually considered is that a high car is cheaper to load than a low car and that high cars may more safely be used on a wide gauge track than upon a narrow gauge. The economy in loading high cars is due to the fact that when it completes its working stroke, the shovel usually has its dipper well in the air. This allows the runner to drop his load without the necessity of lowering the dipper down to the car.

By the use of as large a car as possible, much time is saved on the shovel in the actual spotting of the dipper and through rapid dumping from a greater height. The large, heavy car on standard gauge can stand punishment of this kind which would be impossible with lighter cars. Also the spill will be much less.

The size of the unit of train movement is not always given the consideration which it deserves. For good practice the train load of stone handled on one movement should equal at least 20 minutes of the nominal capacity of the shovel. As for example a railway shovel with a nominal daily capacity of 1,200 tons equals 120 tons per hour, equals 2 tons per minute, should be served by a train carrying 40 tons of stone. In practice, with a daily average of 1,200 tons, this 40 ton train should be filled in from 10 to 15 minutes time and the balance is lost time in moving the shovel, shifting trains, hard digging, etc.

Corresponding figures with a small traction shovel would be 300 tons per day, equals ½ ton per minute, which would require a train of at least 10 tons capacity.

In these figures may be noted one of the fundamental reasons why the small shovel can compete with the large one. Very few operators of railway shovels will serve them with a 40 ton train. The operator of a small shovel has no difficulty in serving it with trains of 10 to 15 tons each. In fact, with a specially designed car, the Cedar Hollow Plant of the Charles Warner Company has succeeded in making train units of 21 tons. This was accomplished on a track of 24-in. gauge, which is altogether too narrow even for shovels as small as ¾ yd.

Even a ¾-yd. shovel is preferably served by a track of 36-in. gauge in order to get sufficiently large train units and a high car that can be loaded more economically. The new type of car at the Cedar Hollow Plant, above mentioned, operates satisfactorily on 24-in. gauge and averages a 3½-ton load. But to secure stability on 24-in. gauge, it is of necessity quite low, which slows up the shovel slightly. Aside from this it is a very satisfactory car.

The relative size of the car and the crusher is of utmost importance and most frequently overlooked. A large car demands a large crusher, all other conditions being equal. If the car is of such small size that its load will not fill and cover over the top of the crusher, then obviously there is much less opportunity of jamming and arching.

This condition is much helped by having a considerable length of chute between the point of dumping the car and the mouth of the crusher. This thins out the load and causes the large stone to go in endwise, thereby permitting the use of

a larger car than would otherwise be possible. An apron feeder or similar device will accomplish the same purpose .

It would be well to reiterate here the important factors that have bearing upon the proper size of the crusher. We constantly hear discussed the relative size of shovel and crusher as if this relationship were the only or the most important point. But the most important considerations of determining the size of the crusher are the nature of the rock itself and the size of the car. The size of the shovel also has an important bearing but certainly less than the others.

Steam shovel service is exceedingly hard on cars. Any car of the "contractor type" or the rocker dump type will not be durable when used with steam shovels. It is necessary to have a type of car in which a considerable portion of the bottom is flat and resting directly upon a heavy decking on the truck. Otherwise the dropping of stone will be constantly knocking the body out of shape. This type of car requires a power dumping device at the crusher. Spring journal boxes are very helpful in saving a car from rough treatment.

It might be well to say one word regarding the use of the motor truck for transportation from shovel to crusher. At least one company is trying this out with reputed success but no cost figures available. Undoubtedly under conditions of a short haul and good roadbed, the motor truck may become popular when used with smaller shovels. But it would appear safer for the average operator to stick to well tried and economical industrial railways rather than experiment with thet high-priced and rapidly depreciating motor truck. The time will come when 3-ton dump trucks can be purchased for $1,800 or less and then a new era will be opened for the quarry operator. In the meantime, he will do well to adhere to accepted practice.

The Crusher.

In most installations the crusher is selected for the size of its opening rather than for its capacity. Since the jaw crusher has a large mouth opening for its cost and output, it is usually selected for all installations of lime plants. The order of importance of different items which go to determine the size of the crusher is approximately as follows:

1. Nature of the stone.
2. Size of the car.
3. Size of the shovel.

The effect of all of these has been elaborated but it would be well to inject a word of caution at this point. Experience has shown that most installations have crushers which are too small for their purpose. Quarry operators install large shovels to secure economy at the quarry face, probably skimp a little bit on the size and type of car and end up with a crusher which is very much too small. The easiest thing to change in a quarry is the size or type of the shovel. Usually the most difficult thing to change is the crusher itself on account of lack of head room, necessity of additional foundations and larger conveying and elevating machinery. Therefore it would appear to be better to put the money into the crusher and if skimping must be done, skimp on the shovel and the rolling stock. Many good installations have been seriously hampered by delays at the crusher itself.

The largest size jaw crusher that can be shipped and erected with a one-piece frame is the 48x60-in. Any size larger than this must be shipped knock-down on account of railroad limitations. As a result this size crusher is now being frequently installed. It is being successfully fed by shovels of various sizes running from a ¾-yd traction shovel at Cedar Hollow Plant of the Charles Warner Company up to 3-yd railway shovels at the plant of the Security Cement & Lime Company and at some of the Ohio lime manufacturing plants. This crusher is not quite large enough for this work. But it has been the economic limit for these plants on account of the excessive cost involved in the purchase and installation of the larger sectional frame crusher. There is occasional difficulty at all the plants using this crusher which is usually due to the nature of the rock or failure to supply a sufficiently long chute from the car dumping point to the crusher mouth.

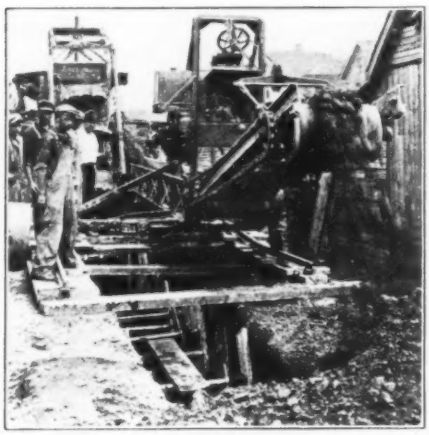
Other plants have installed crushers of size 42x48-ins. and 40x42-ins. This has been an unfortunate economy since almost any shovel or any naturally hard-bodied rock will cause considerable jamming and arching with these smaller size crushers.

The gyratory crusher should only be considered where enormous capacity is desired, say 4,000 tons per day or more, such as is required in large fluxing stone operations.

The foregoing matter is from a paper by Mr. Warner before the recent annual meeting of the National Lime Association.

SEWER TRENCH BACKFILLER WORKS IN 11 FT. ALLEY.

There is an ever increasing demand for sewer construction in alleys, rather than in the streets. Without a continuous backfiller any trenching machine is practically useless, due to insufficient space in a 16-ft. alley to deposit the dirt, especially if the trenches happen to be deep. Depositing the excavated dirt on one side only is the logical method, the other side being used on which to string out the pipe. De-



AUSTIN CONTINUOUS BACKFILLER FOR SEWER TRENCHES WORKS IN 10 FT. 6 IN. ALLEY.

positing the dirt on both sides is a nuisance and even then, there is insufficient space to permit economical handling of the job. Then comes the backfilling to be done by hand or by teams in congested space. Thus the ordinary traction backfiller is at a big disadvantage for obvious reasons.

The Austin Machinery Corporation's continuous backfiller, shown in the illustration, while adapted for alley work, is also ideal for work in the open.

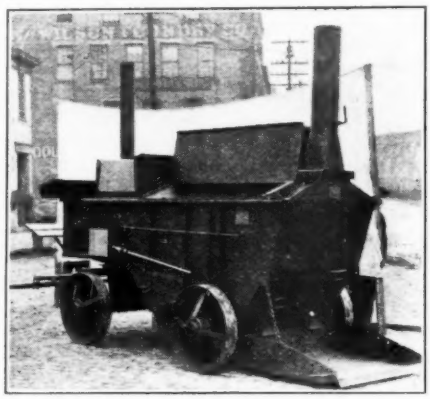
A short conveyor takes the excavated material from the standard cross conveyor belt and delivers it to the main belt, which, driven by gasoline engine, and therefore independent of the power on the trenching machine, carries the dirt back and into the trench. The device moves on short light rail sections, and is attached to the trenching machine for traction purposes. The rear end is supplied with a winch for raising and lowering, so that wagons can be loaded without any difficulty. The backfiller is built in sections of 4 ft. 6 ins., so that any reasonable length can be used, the conveyor belt being lengthened or shortened up accordingly.

The especially important part of this device is that it operates within the outside measurement of the trencher, so that in an alley 10 ft. 6 ins. wide this trenching machine can be used.

THE ANDRESEN ROAD REPAIR OUTFIT

Until quite recently there has been no single piece of apparatus on the market with which all types of pavements could be properly maintained. For instance, to repair asphalt streets has necessitated the use of expensive asphalt plant, wagons or motor trucks, road rollers, tool-heater wagons, etc. The result has been that many cities and counties, due to the large expense involved in equipment, could not afford or were not justified in purchasing machinery with which to make necessary repairs. The natural result has been that many roads and pavements have rapidly gone to pieces due to want of proper maintenance.

A machine to fill the need so described was patented and placed on the market about a year and a half ago by H. P. Andresen & Co., 1261 N. Clark St., Chicago. This machine, which is built by



THE ANDRESEN ROAD REPAIR OUTFIT.

Littleford Bros., 460 East Pearl St., Cincinnati, Ohio, has been perfected under service conditions. It is well suited to the road patrol or gang system of maintenance, for with this machine no other equipment is necessary for patching any type of road, whether asphalt, bituminous concrete, cement concrete, brick, water bound and asphalt macadam. It is primarily intended to make small repairs

before larger, more expensive ones become necessary.

The machine is drawn by a truck, or team of horses, and carries all necessary materials, tools, heating appliances and the 3 or 4 men required to operate it. With this plant it is not necessary to use rollers, tool heaters, tar kettles or wagons and an asphalt plant is not required. Large cities can use this output to advantage in conjunction with their asphalt plants for the patrol system of repairs.

The outfit is well suited for emergency Portland cement concrete work in the winter; hot water, hot stone, hot sand and mixing device all in one apparatus. With this outfit road and street maintenance work can be done throughout the year, thus making use of men necessarily carried on the payroll through the winter months to keep an organization intact.

There is but one fire. Temperature control, so necessary when working with bituminous materials, is obtained by the use of two stacks, each provided with a self-locking damper. If the asphalt in the removable kettle in the forward end of the wagon becomes too hot, by closing the damper in front stack all the heat necessarily goes under and through the sand and stone bin to the rear stack, and vice versa.

There is no waste of coal or of paving materials, for the asphalt (water or tar), sand and stone are all discharged direct by gravity into the combination mixing pan at the rear. There is no necessity for rehandling material ordinarily left along the roadside, as a consequence no unsightly mess remains. The mixing pan when raised becomes the tool carrier.

The Andresen Road Repair Outfit combines in a single device a heating or melting kettle, two bins for heating sand and stone, a combination mixing pan and tool carrier, a heater for tampers and smoothers, a coal burning furnace, a coal bin, a cement bin, space on top of bins for carrying materials and tools, a hot shelf for keeping pouring pots warm, and a driver's seat large enough for four men. These parts are compactly mounted on a single set of four wheels and are arranged so that the material charged into the wagon at the top is heated and delivered simply by force of gravity to the mixing pan at the rear. It is constructed entirely of steel excepting the driver's seat, foot board, wagon pole and trees.

Contracts Awarded

ROADS AND STREETS

Ark., Arkadelphia—East Brothers, Arkadelphia, awarded contr. for surfacing with gravel certain street and Federal roads in Clarl Co. Rd. Improvement Dist. No. 1, at $89,653.

Ala., Jasper—Jerry Gwin, Birmingham, Ala., awarded contract to construct Bankhead hwy. thru Walker Co.; 30 ft. wide, with 16-ft. hard surface gravel, at $135,000.

Ala., Livingston—W. K. Saulsbury & Co., Birmingham, awarded contr. for 9 miles bitum. macadam paving, penetration method, at $177,000; 9 mi. clay and grav. constr. to Finnel Co., Tuscaloosa, at $123,000. Both contracts awarded by Board of Revenue, Sumter Co., Ala., State and county will each contribute $75,000 and Federal government $150,000.

Ala., Tuscaloosa—Thompson & Donoho, Birmingham, Ala., awarded contr. to construct 25.2 miles Byler rd., at $223,000.

Cal., Sacramento—Henry J. Kaiser, Oakland, awarded contract for paving and grading bet. Upton and southerly boundary of Siskiyou Co., at $18,515, and bet. Healdsburg and Cloverdale at $350,000.

Cal., Santa Barbara—Samuel Hunter and Chas. T. Richardson, 525 E. Haley St., Santa Barbara, awarded contract for paving 23 miles of highway in the Lompoc permanent road div., with 3½-in. asph. conc. base, and 1½-in. surface, at $485,535.

Colo., Trinidad—Strange & McGuire, Boulder, awarded contract for paving here at $178,381.

Ill., Waukegan—F. C. Nelson, Racine, Wis., awarded contract for paving 4.5 miles Wauconda-Volo rd., 18 ft. wide, concrete, at $137,995.

Ia., Audubon—Geo. Condon Co., 415 Farnam Bldg., Omaha, Neb., awarded contract for excavating 17 miles, at $116,500.

Ia., Iowa City—Wm. Horrabin, Iowa City, awarded contract for paving various streets, $8,000 brick paving; $57,000 bitulithic.

Ky., Frankfort—State Hwy. Dept. let contract for shaping and draining 6.2 mi. Somerset-Stanford rd., Pulaski and Lincoln Cos., to W. Lutes & Co., Lexington, at $105,834; shaping, draining and surfacing with rock asph. 1.4 mi. rd. from east to southwest corp. limits of Scottsville, Allen Co., to Speed Parker, Inc., Speed bldg., Louisville, at $57,560; surf.-treating roads in Nelson, Rockcastle, Warren, Bourbon and Woodford Cos., to R. B. Tyler, 114 S. Fourth St., Louisville, at $29,071; Anderson and Garrard Cos. to Eaton Oil Works, Covington, at $7,482; Madison Co. to Southern Oil & Tar Co., Louisville, at $10,252.

Ky., Frankfort—Wm. Lutes & Co., Lexington, awarded contracts for 6 2-10 miles waterbound macadam, Lincoln Co., at $105,000; Speed-Parker Co., Louisville, awarded contract for 1½ mi. city impvts. in Scottsville, Allen Co., at $55,000.

Ky., Louisville—Louisville Asph. Co. awarded contract to constr. 4.5 miles rein. conc. on Bardstown rd., St. Proj. 3, Sec. A, F. A. P. 50, at $161,582.

Ky., Richmond—Geo. T. Miller, Lebanon, Ind., awarded contract to construct 7 miles rein. conc. on Dixie Hwy., Madison Co., at $243,287.

Ky., Sanford—Wm. Lutes & Co., Lexington, Ky., awarded contract to constr 6.2 miles waterbound macadam road, at $105,000.

Ky., Winchester—State Hwy. Comn., Frankfort, let contr. to S. M. Billiter, Covington, Ky., for constructing 9.5 miles Ky. rock asph. on Midland Trail in Clark Co.; State Proj. 47, Sec. A, F. A. P. 63, at $352,889.

La., Abbeville—W. E. Goron, New Orleans, awarded contract in Rd. Dist. 1, in 8th Ward of Vermillion Parish at $350,000.

La., Gretna—T. W. Johnson, 2323 Chestnut St.,

New Orleans, awarded contract for curbing and bldg. 82,000 sq. yds. conc. walks, at $304,555.

Me., Augusta—Frissell Eng. Co., Gardner, Mass., awarded contract for paving 3.59 miles State hwy. in Bangor and Veazie, 18 ft. wide, concrete, at $64,483; 3.1 mi. in Turner and Livermore, 18 ft. wide, gravel, to J. H. Kerr, Rumford, at $55,876.

Mich., Lansing—St. Hwy. Dept. let contr. to Remus Constr. Co., Remus, for grading, draining and surfacing State trunk line rd. 13-20, at $71,673; M. J. Bacco, Iron Mountain, contr. for grading, draining and surfacing 3.883 mi. State trunk line rd. 90-1, Sec. A, Dickinson Co., at $36,618.

Minn., Grand Rapids—Following awarded contrs. for 27 miles conc. paving bet. Grand Rapids and Keewatin, 2 mi. paving in Grand Rapids, 1 mi. in Coleraine, to be laid this season, 13½ mi. bet. Grand Rapids and Marble, to Johnson, Drake & Piper, 912 Plymouth Bldg., Minneapolis, at $417,958; 13½ mi. bet. Marble & Keewatin to Winston Bros., 801 Globe Bldg., Minneapolis, and E. W. Coons Co., Hibbing, at $411,929, both sects. conc. paving with 50-lb. mesh reinf. and crushed rock aggregate.

Mo., Kansas City—G. G. Roudebush, awarded contract for paving Quindaro blvd., from 5th St. to 17th St., at $168,878; C. C. Clark, Topeka, awarded contr. for grading, paving and bldg. culverts along Southwest blvd., from city limits of Rosedale to Johnson Co. line, at $79,164.

Mo., Kansas City—W. G. Mullins Constr. Co. contr. to pave 31st St., Troost Ave to Woodland Ave., at $26,661; Gray Paving and Material Co., at $15,147, to pave 9th St., Campbell to Troost; Fred Lorrimer contr. to pave Oak St., 63rd to Meyer blvd.; W. D. Doyle Constr. Co., to pave Walrond Ave., Benton blvd to Benton Ave., at about $100,000.

Mont., Butte—Heislet Constr. Co., Salt Lake City, Utah, awarded contr. for constr. of Pipestone Pass rd., south of here, at $73,000; 18 miles long.

Neb., Omaha—Peterson, Shirley & Gunther, Omaha, awarded contr. by Bremer Co., Iowa, F. A. P. 88, for grading 10.7 miles west and east of Waverly, estimate quantities, 86,955 cu. yds. earth excav. and 1,007 cu. yds. solid rock excav. at 42c per cu. yd. and $3 per cu. yd. respectively.

Neb., Omaha—American Paving Co., 411 Finance Bldg., Omaha, awarded contr. for repaving Dodge St., at total of $100,000.

N. J., Mt. Holly—Union Paving Co., 30th & Locust Sts., Phila., awarded contr. for paving Mt. Holly-Burlington rd., sheet asph., at $323,992.

N. J., Salem—M. Staub, Sweedsboro, awarded contr. for rein. conc. paving; 47,146 sq. yds., Woodstown-Salem rd., Route 6, Sec. 7, at $166,637.

N. C., Tarboro—Cheatwood & Driscoll, 511 W. 12th St., Richmond, Va., awarded contr. by State Hwy. Dept., at Div. Office here, for grading and paving 9.57 mile road bet. Greenville and Ayden, Pitt Co., at about $237,000.

N. J., Trenton—J. J. Barrett, 147 Lafayette St., awarded contract for paving 2 miles Carter rd., from Lawrenceville to point near Rosedale, waterbound macadam, at $158,072; J. J. Barrett, 147 Lafayette Ave., awarded contract for impvt. of Chambers St. and Princeton Ave., $4,500 ft. long, 20 ft. wide, at $39,521.

N. C., Charlotte—Blythe & Blythe, awarded

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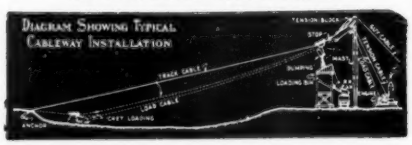

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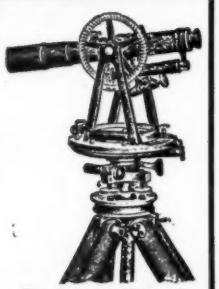

The Popular Kolesch "PIONEER" TRANSIT No. 7710

contr. by Mecklenburg Hwy. Comn. for constr. of 3¾ miles Lawyers rd., bet. Charlotte twp. limits to seven mile post; road surface of conc. mixture and surface asph., $105,000.

N. C., Durham—Hutton Eng. & Contg. Co., Savannah, Ga., awarded contr. for clearing, grubbing, draining and paving 5.8 miles State proj. 573, at $192,340.

N. C., Kinston—Eagle Eng. Co., Newbern, awarded contr. for clearing, grubbing, draining, grading and paving 2.65 miles State proj. 516, Craven Co., at $105,080.

N. C., Washington—H. T. Hadlow Co., Jacksonville, Fla., awarded contr. for road paving here at $370,000. The road will be of concrete and will be built just outside of Washington; 10½ miles in length.

Okla., Bristow—Standard Paving Co., Tulsa, awarded contract for 9 blocks paving on Main St., at $128,000.

Okla., Pawhuska—Stanon & American Paving Co., Wichita, Kans., awarded contr. to constr. 17,000 yds. brick pavement, at $175,000.

Ohio, Montgomery—E. R. Ryan, care commrs. Montgomery Co. Court House, Dayton, awarded contract for paving 5,000 ft. Germantown St. here, from Lakeview to corp. line, at $88,346.

Ohio, Steubenville—Reagan & Lynch, Steubenville, awarded contract for paving 11,921 ft. Wharton Twp. rd., vitr. brk., at $119,371.

Ore., Portland—White, Brown & Leahy, awarded contr. for impvt. of 8½ miles of road thru government forest to the Josephine Co. caves, at $126,000.

Ore., Salem—State Hwy Comn. let contr. for grading 16.8 mi. highway in Lake Co., to Lake Co. Court, Lakeview, at $57,715; 10.8 mi. in Lincoln Co. to A. Giebisch, Portland, at $83,415; grading and macadamizing coast highway in Clatsop Co. to J. Slottle & Co., Astoria, at $45,203; 2.7 miles in Wheeler Co. to D. F. Murphy & Co., Boise, Idaho, at $34,056; paving 7.8 miles in Linn Co., to A. D. Kern, Portland, at $237,131.

Pa., Harrisburg—McNichol Paving & Constr. Co., 1923 Cherry St., Phila., awarded contr. for bldg. Route 281, Bucks Co., at $346,555.

Pa., Pottsville—American Paving and Material Co., Chester, awarded contr. for paving a number of streets with asphalt, at $283,000.

Pa., Philadelphia—Jno. Meehan & Son awarded contr. for paving Delaware Ave., Chestnut St. to Queen St., with granite blocks, at $242,200.

Pa., Philadelphia—Following contrs. awarded by city: Union Paving Co., repaving portion Germantown Ave., $88,000; Eastern Paving Co., repaving portion Main st. and Ridge ave., at $77,500; Union Paving Co., repaving Woodland Ave., $63,400; Ryan Constr. Co., repaving 6th St., $52,000, also 6th, York to Allegheny, at $59,100; Robert Lombardi, repaving 5th and 6th Sts., at $85,100; McLaughlin & Flood, repaving 5th St., $67,300; Michael J. McCrudden, repaving Ridge Ave., at $106,200.

S. C., Kingstree—Adams, Evans & Co., Jacksonville, Fla., awarded contr. to constr. 40,000 sq. yds. asph. conc. paving, besides walks, drainage, etc., at $160,000.

Tenn., Nashville—Little & Dean, Shaw, Miss., awarded contr. for constr. of 19.54 miles hwy. in Henry Co., bet. Paris and Ky. State line, at $412,002.

Tenn., Paris—State Hwy. Dept., Nashville, let contr. to Little & Dean, Shaw, Miss., to constr. 19.54 miles gravel road bet. Parish and Ky. State line, Henry Co., including bridges and drainage structures, at $412,602.

Tex., Comanche—Harris & Powell, Tyler, Tex., awarded contr. to constr. gravel road on Dublin-Goodman rd, by way of De Leon, 17 mi., and from De Leon toward Comanche, 8 mi., at $261,000.

Tex., Crockett—Smith Bros., Crockett, awarded contr. by Commrs. Court, Washington Co., Brenham, for approx. 31 miles gravel and conc. hwys., at $810,000.

Tex., San Augustine—D. La Roe, Palestine, awarded contr. for clearing, grubbing, grading, graveling and draining 21 miles hwy. 21, at $217,407.

Tex., San Augustine—McClung Constr. Co., Sherman, Tex., awarded contr. to constr. Kings hwy. thru San Augustine, at $230,000.

Va., Norfolk—Dawkins Constr. Co. awarded contr. for paving here to cost $89,724.

Va., Richmond—Sanderson & Parker awarded contr. for 1½ mi. conc. road and 8¼ mi. soil rd., bet Farmville and Prospect at $99,667; Hamilton Constr. Co. awarded contr. for 7¾ mi. soil rd., bet. Rice and Burkville, at $51,802; Roberts Constr. Co., awarded contr. for 4¼ miles surf. treated macadam from Glenvar west to Montgomery Co. line, at $67,813; Marshall Bros. contract for 3 rein. conc. bridges on Salem-Catawba, at $19,767.

Va., Wise—Hottel & Co. awarded contr. to constr. 6¼ miles of road bet. Coeburn and St. Paul, at $181,000; Scott, Trinkle & Beverly contr. to build road from Riverview to Tacoma, at $125,000.

W. Va., Charleston—City let approx. $250,000 paving contrs. to Southern Engrg. Co. as follows: Duffy St., Kanawha to Va. St.; Columbia Ave., Virginia to Charleston Sts.; Penn. Ave., Columbia blvd to Monongalia St.; Wyoming Ave., Columbia Ave. to Penn. Ave. etc.

SEWERAGE AND SEWAGE TREATMENT.

Ont., Niagara Falls—Johnston Bros., 43 Market St., Brantford, Ont., awarded general contr. for constr. of trunk sewer, costing $238,000.

Ct., Torrington—Town plans to improve sewerage sys., vitr. pipe; about $351,000; work will be done by day labor.

Ill., Elmhurst—F. J. Donohue, Stevens Point, Wis., awarded contr. for constructing 2,790 ft. 15-in. vitr. tile sewers, etc., in various streets, at about $40,000.

Iowa, Dubuque—Even-Uhlrich-Stoner Co., Dubuque, award. contr. for bldg. 12-24 in. sewers in Lincoln and Ann Sts., at about $60,000.

Iowa, St. Ansger—E. L. Royer, 1322 32nd St., Des Moines, awarded contr. for sewer sys., at $53,598; 79,000 ft. of 8 to 12-in.; disposal plant to Ward & Weighton, 516 Davidson Bldg., Sioux City, awarded contr. at $10,900.

Kans., Ft. Scott—American & Snyder, 248 N. Market St., Wichita, awarded contr. for bldg. sewers in various streets, at $42,516.

Mass., Boston—A. Baruffaldi, 20 Hale St., Boston, awarded contr. for sewerage work in Glendale rd. outlet and North ave., W. Roxbury, at $46,554; B. E. Grant Co., 605 Brewsters Hills, Boston, awarded contr. for wood blk. pavement in Charles St., at $38,399.

Mass., Northbridge—McClintock & Woodfall, 14 Beacon St., Boston, awarded contr. for extension of sewerage sys. at about $60,000.

Mich., Detroit—A. J. Penote Co., 6717 Quimby Ave., Cleveland, awarded contr. for constr. of conduits, manholes, etc., at $268,134.

Mich., Detroit—Booth & Flinn, 114 Cadillac Savings Bldg., awarded contract for Sec. 4, Bates St. sewer, at $492,556; Alfred St. arm of Bates St. sewer, at $104,575; G. R. Cooke, 1260 Penobscot bldg., Sec. 4, Jos. Campau Ave. sewer, $413,836; Sec. 1, Highland Park arm., $493,903; W. Porath, 1410 W. Grand blvd., 3rd Ave. sewer, at $15,866; R. D. Baker, 1631 Elmhurst Ave., 6 mile rd. sewer, at $36,366; Detroit Contg. Co., 827 Ford Bldg., Lat. 3318, $20,933; Lay, 3319, $14,129; Lat. 3320, $13,346; Lat. 3478, $8,055; Lat. 3496, $5,212; Lat. 3498, $5,308; Liberty Constr. Co., 36 State St., Lat. 3420, $3,830.

Minn., Duluth—Salo & Winnimaki, Duluth, awarded contr. for sanitary sewer in Mankato alley, from Helstad Ave. to Wabash Ave., at $1,384; Parvi & Hendrickson, Duluth, contr. for sanitary sewer in Gilliat St., from 40th Ave. east to Luverene Ave., at $1,944.

Minn., St. Paul—Barbarossa & Mnetto, St. Paul, awarded contr. for constr. of sewer on Sheldon Ave., at $1,721; Thornton Bros., 304 Cent. Bank bldg., St. Paul, awarded contr. for constr. san. sewer sys., at $50,787.

Mo., Excelsior Springs—Harness Bros., Ottumwa, Ia., awarded contr. for 10 18-in. vitr. tile sewers and disp. plant, at $54,385.

Neb., Arapahoe—Katz Constr. Co., 404 Finance bldg., Omaha, awarded contr. for san. sewers at $30,880.

Neb., Chadron—Morrissey Constr. Co., Chadron, awarded contr. for a septic tank and sewer at $37,821.

Neb., North Platte—Carl Backers, awarded contr. for sewer constr., at $65,000.

N. Y., Buffalo—Following contrs. let for sewer construction: Dark & Co., 653 Main St., Buffalo,

at $79,777; Jno. M. Fahning, 460 Leroy Ave., Buffalo, at $4,640.

Ohio, Cleveland Heights (Warrenville P. O.)—Cedar Heights Land Co. let contrs. to Hadden-Hall Co., Schofield bldg., Cleveland, for bldg. sewers in Wynn Ave., $2,188; Raymont Ave., $18,700; Tellamore Ave., $9,569; Farland Ave., $3,017; Cedar Brook blvd., $10,124; Jackson Ave., $12,902. Work involves 18,080 ft. 12-24 in. vitr. pipe.

Ohio, Columbus—City let contr. for bldg. sewage pumping sta. on Nelson rd. to R. H. Evans & Co., 8 E. Broad St., at $15,868; equipment to Dravo-Doyle Co., Diamond Bank bldg., Pittsburgh, at $6,098; laying trunk sewer thru Linden to Gaty Constr. Co., 185 N. Water St., at $68,486.

Ohio, Dayton—C. F. Smith & Son, 54 Davies bldg., awarded contr. for bldg. storm and san. sewers in Fairview Sub. Sewer Dist. No. 1, at $164,459.

Ohio, Linden—Gaty Constr. Co., 185 N. Water St., Columbus, O., awarded contr. for laying Linden trunk sewer at $68,487; Robt. H. Evans, Cole Savings & Trust Bldg., Columbus, O., awarded contr. for installation of sewage pumps at Nelson Rd. Sta., at $15,805; Dravo-Doyle Co., Diamond bldg., Pittsburgh, awarded contr. for additional equipt.

Ohio, West Park—City let contr. for laying sewers and water mains in Sprecher, Carrington, Metherson, Leeila, Williams, Cloverdale Aves., and W. 127th St., to Sprague & Burkhart, 12011 Woodland Ave., Cleveland, at $33,495; Belmont and Rockport Aves. to E. Egan, 720 Caxton bldg., Cleveland, $18,482. Work includes 8,200 ft. 12-24 in. vitr. pipe.

Okla., Ada—I. E. Hanson awarded contr. for sewer in Sewer Dist. No. 15, at $40,500.

Okla., Guthrie—W. F. Power, city, awarded sewer contr. by city council of Ralston, at $35,000.

Ore., Portland—Council ended long drawn out controversy over Foster rd. sewer by awarding contr. to build the 28-in. monolithic sewer to J. F. Shea, at $319,911.

Pa, Pittsburgh—Pittsburgh Paving Co., Bakewell bldg., awarded contr. for bldg. relief sewers in Homewood Dist, at $63,538.

S. C., Barnwell—Concrete Constr. Co., Columbia, S. C., awarded contr. to install sewer system at $55,000.

S. C., Orangeburg—General Road Drainage & Constr. Co., Columbia, S. C., awarded contr. for sewer extensions at $47,912.

S. D., Watertown—Bruce-Bickelhaupt Co., Yankton, awarded contr. for bldg. storm sewers in various streets at $41,700.

Wash., Seattle—Interstate Constr. Co., Seattle, awarded contr. for constructing sewers in Findlay St., at $25,730; Agostino & Alex., Seattle, contr. for sewers in Densmore Ave., at $1,633.

WATER SUPPLY AND PURIFICATION.

Canada, N. B., Devon—General contr. for intake pipe costing $40,000 for town, awarded to Gale Bros., St. John, N. B.; Pacific Coast Pipe Co., 1551 Granville St., Vancouver, B. C., awarded contr. for 6-in. and 8-in. Douglas fir woodstave pipe, at $10,000.

Canada, Ont., Richmond Hill—Following contrs. let in connection with the installation of a waterworks system: Laying water mains to F. F. Fry, Toronto; supplying cast iron pipe to the National Iron Corp.; elevated steel tank, Canadian Des Moines Steel Co.; filter equipt. General Supply Co., Canada, Ltd.; filter bldg., pumphouse, dam and bridge, Reid and Somers, Elora, Ont.; gate valves and hydrants, Drummond, McCall Co.; pumping machinery, Northern Foundry Co., Sault St. Marie, Ont. Total cost will be approx. $90,000.

Canada, Ont., Scarboro Twp.—Central Foundation Co. awarded contr. for laying approx. 6 miles of water mains at about $75,000.

Dela., Wilmington—Delaware Bronze Co., 320 8th St., Wilmington, awarded contr. for brass and aluminum castings, at $50 000.

Ill., Mattoon—A. C. Loomis, Mattoon, awarded contrs. for reconstr. of "Paradise" reservoir, increasing capy. to 1 000,000,000 gal., concrete work; dirt work to H. L. Powel, Mattoon, total cost about $125,00.

Ill., Washington—W. Elbert, Washington, awarded contr. for increasing waterworks capy. from 200,000 to 400,000 gals. per 24 hrs., at $75,450.

Ky., Harrodsburg—City let following contrs. for impvts. at water plants: P. N. Wilson, Harrodsburg, $20,917, to construct dam; K. K. Kerns, Frankfort, Ky., to constr. filter. plant; Norwood Filter Co., Florence, Mass., at $13,115; to instal filter equipt.; Jno H. Adams Co., Harrodsburg, at $21,389, to extend water main.

Mich., Bay City—Wm. J. Meagher, Bay City, awarded contr. for laying water mains at $382,063.

Minn., Forest Lake—O'Neill & Preston, 608 Exch. Bk. bldg., St. Paul, awarded contr. for bldg. waterworks system, at about $75,000.

N. J., Gloucester—Following contrs. let for reconstr. water works and pumping station, stand pipe to Chicago Bridge & Iron Co., 30 Church St., New York City, at $16,450; sediment basin, foundations and pumping station bldg. to Nelson Pedley Co., Lincoln Bldg., Philadelphia, at $34,900; machinery and piping to Electric Power & Eng. Co., Philadelphia, at $39,000; 2 wells to Artesian Well Drilling Co., Real Estate Trust bldg., Philadelphia, at $4,000.

N. M., Estancia—Orman Constr. Co., Pueblo, awarded contr. for construction of water plant and sewer system at approx. $50,000.

N. Y., New York City—Dept. Water, Gas and and Electricity, Municipal bldg., let contrs. for furnishing, delivering and laying water mains and appurts. in Concord, Jackson, Melrose, Prospect and Trinity Aves., E. 144th, E. 155th and E. 120th Sts., Bronx Boro to Paladino Con. Co., 437 E. 120th St., at $139,364; First Ave., Dyckman, E. 117th, W. and Marginal Sts., Manhattan Boro. and Laugh, Pierce and Van Nest Aves., E. 138th and Adams Sts., Bronx Boro, to C. Deblasio, 17564 Honeywell Ave., at $31,731.

Ohio, South Euclid—Village let contracts for laying water mains in Golfway, Lawnway, Maywood and Rushton Aves., Oakmont, Laclede, Renford, Westdale, Bayard and Green roads, to A. Marra, Ullmer bldg., Cleveland, at $107,070; Piermont, Delwood, Ardmore, Adrian and Elmwood Aves., Winston and Avondale rds., Belvoir blvd. to Hadded-Mall Co., Schofield bldg., Cleveland, at $111,817.

Pa., Philadelphia—Beam & Craven Co., Real Estate Trust bldg., awarded contr. for bldg. 60-in. steel pumping main at Norristown pumping plant, at about $165,000.

Pa., Philadelphia—Contracts awarded as follows: J. Joseph McHugh, 1430 Penn. Sq., Phila., for furnishing and laying 60-in. pumping main of steel pipe, $300,000; Dravo & Doyle, Commercial Trust bldg., Philadelphia, for furnishing and erecting motor driven pumps, $19,000; B. F. Sturtevant Co., 15 Damon, Hyde Park, Boston, Mass., awarded contr. for furnishing and installing one fuel economizer, at $32,000; Autocar Sales & Service Co., 23rd and Market, Philadelphia, furnishing two chassis, $2,710; Worthington Pump & Machy. Corp., 115 Bway., New York, furnishing and delivering diffusion rings, impeller, etc., $5,200; United States Cast Iron Pipe & Foundry Co., E. Burlington, N. J., flanged specials at $6,000; Combustion Engr. Corp., 43 Broadway, New York City, furnishing traveling grate stokers, $41,534; Beam-Craven Co., 605 Market, Philadelphia, furnishing and laying steel pumping main, $152,126; Kennedy Valve Co., 95 John St., New York City, for furnishing 6, 8, 10 and 12-in. stop valves, at $13,839.

Tex., Dallas—Hughes-O'Rourke Co., Dallas, Tex., awarded contr. for constr of White Rock filtration plant, at $223,794; Pittsburgh-DesMoines Steel Co., 4th and Ross Sts., Pittsburgh, Pa., awarded contr. for steel towers and tanks, at $7,960.

Prospective Work

ROADS AND STREETS.

Ark., Van Buren—More than 90 miles graded dirt road, with specified culverts and steel bridges, will be built in the Southern Crawford Co. Rd. Impvt. Dist. Est. cost approx. $400,000.

Ariz., Phoenix—City Comn. has adopted resolutions of intention for following street work: Bitu-

Highway Construction Equipment Service

If in the market for any of the following highway construction equipment, so indicate by check marks, mail this page to ***Municipal and County Engineering,*** 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
—Asphalt Plant, Portable
—Asphalt Plant, Railroad
—Asphalt Tools
—Asphalt Tool Wagon
—Bar Cutters and Benders
—Bars, Reinforcing
—Bins, Portable Stone
—Bodies, Dump Truck
—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
—Industrial Cars
—Industrial Track
—Manhole Covers
—Mixers, Building
—Mixers, Hot
—Mixers, Paving
—Motor Trucks (1-3 tons)
—Motor Trucks (over 3 tons)
—Oil Distributors
—Portable Conveyor
—Portable Drilling Rigs
—Pile Drivers
—Reinforcing Steel
—Road Drags
—Road Forms
—Road Graders
—Road Mesh
—Road Planes
—Road Plows
—Road Rollers
—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
—Scrapers, Power
—Sheet Piling, Steel
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
—Tampers, Road
—Tractors
—Trailers
—Turntables
—Unloaders, Car
—Wagon Loader
—Wheeled Scrapers
—Wire Mesh

lithic paving with cem. conc. base and cem. curb and gutter, conc. driveways, etc., in First St., bet. Madison and Jefferson Sts.; conc. paving 6-in. thick and cem. curb and gutter, conc. driveways, etc. in Washington St., bet. 5th and 16th Sts.; conc. paving 6-in. thick and construction conc. curb and gutter in Madison St., 7th to 8th Sts.; Jefferson St., 7th to 9th Sts., and in 8th St., Madison St. to Washington St.

Ariz., Phoenix—At meeting of Co. Hwy. Comn., and Board of Supvrs. it was stated that paving of Buckeye rd. from Agua Fria river to Buckeye, an 18-mi. stretch, would be completed under first bond issue, and that the work would start in near future.

Cal., San Francisco—City Engr. W. M. O'Shaughnessy has received largest petition ever filed with his office for pub. impvt. to be paid for by private prop. owners. Petition requests impvt of sts. in Mission Terrace sub div., bet. San Jose Ave., Ocean Ave., Cotter St. and Mission Creek. Total est. cost, $100,000. Plans and specfs. now being prepared.

Cal., San Francisco—Plans and specfs. for the $130,000 impvt. of Point Lobos Ave., bet. 48th Ave. and Gt. Hwy., approved by Board of Supvrs., Comm. on Streets and Sewers.

Cal., Fresno—Resolutions of intention to improve following streets adopted by city comn.: Roosevelt Ave., Belmont to Olive Aves., to be graded and paved with asph.; Poplar Ave., McKinley to Home Aves, to be graded and oiled; Echo Ave., Belmont to Olive Aves, and part of Elizabeth St., to be graded and paved with asphalt, curbs, walks, gutters and culverts.

Cal., Huntington Park—Board of Trustees adopted resolutions of intention for following street work: Grading, paving with asph. conc., and constructing conc. gutter in Clarendon Ave., Miles Ave. to east city boundary; grading, paving with asph. conc. and constructing conc. gutter in Passaic St., Randolph to Irvington Ave.; grading, paving with asph. conc. and constructing conc. gutter in Gentry St., Clarendon Ave to Irvington Ave.

Cal., La Habra—Chamber of Comm. has decided to improve Cypress and Hiatt Sts. with high curbs to carry storm waters coming thru town. Proposed paving program comprises about 2 miles of streets.

Cal., Newman—Property owners outside street paving impvt. now in progress have petitioned town trustees to include their streets in new paving district. Acting on petition trustees decided to go ahead with the additional paving, which will cover 18 blocks, making total of 32 blocks to be paved.

Del., Wilmington—Land owners circulating petition to Levy Court to have River rd. paved. Est. cost $100,000.

Fla., De Land—City plans expending $500,000 to constr. 8 miles of paving and sewerage; enlarge and extend water works.

Idaho, Coeur D'Alene—Council voted favorably on petition to pave 4th St., Harrison Ave. north to city limits, about 1 mile. Alleys in business district will also be paved.

Iowa, Davenport—Several impvts. came up for consideration before Rock Island City Comn. Ord. providing for paving with asph. conc., 19th and 20th Aves, 24th to 27th Sts., and 25th St., 18th to 20th Aves, passed. 20th Ave., 9th to 12th Sts., will be resurfaced and 19th St., 7th to 10th Aves, will be repaired.

Kans, Downs—Benham & Mullergren, Cons. Engrs., Firestone bldg., Kans City, Mo., retained for engineering work on proposed paving here. Resolutions passed to pave 16 blks. and more will follow.

La., Colfax—Grant Parish will build and gravel 85 miles of rd.; $570,000 bonds sold.

La., Monroe—Duncan Buie, St. Hwy. Engr. has promised Police Juries, E. & W. Carroll and Morehouse parishes that as soon as Federal and State aid is given a hwy. will be built from Lake Providence to Lane's Ferry. This will connect Bastrop, Oak Grove and Lake Providence. Sale of $1,600,000 road bonds may be negotiated.

La., New Orleans—City plans to pave 17 and repave 8 streets; granite blocks, creo. wood block, bitum. conc., and other material. A Klorer, City Engr.

La., Ruston—Lincoln Parish will sell $700,000 bonds for road constr. S. J. Heard, Pres. Police Jury.

Mass., Boston—Council passed favorably on request for repaving Congress St. and Postoffice Sq., at cost of $40,000 (wooden blks. will be used). Ords. also passed for widening Wash. St., Corinth to La Grange, in connection with State's plan for exten. of Washington St., across W. Roxbury Parkway. Est. cost for widening, $100,000.

Mich., Grand Rapids—Arrangements for paving Leonard Hill this fall were practically agreed upon when Commr. Wm. Oltman and Pub. Serv. Director G. J. Wagner took up matter with State and Co. Hwy. Commrs. State Hwy. Commr. Frank F. Rogers consented to have half mile rd. in city paved with brick.

Mo., Kansas City—Bd. Pub. Wks. adopted resolution providing for grading Warwick blvd., south from McGee St., trafficway to 26th St. City also contemplates widening 31st St. Est. cost, $1,026,000.

Mo., Kansas City—Following resolutions adopted: Grading 58th St., from Paseo to Prospect Ave.; Oakley Ave., 24th to 25th Sts.; reconstr. asph. pavement, Madison St., 17th to 19th Sts.; repave 11th St., Wyandotte to Baltimore Ave., with rock asph.; W. Prospect St., 16th to Adaline Court, rock asph.; pave with plain conc.; 44th St. Terrace, Bway. to Wornall rd.; alley, Holmes, Cherry, 28th and 29th Sts.

Mo., St. Charles—$200,000 bonds will be sold for road constr. Herbert C. Sandfort, Clk. Co. Court.

Minn., St. Paul—Proposed paving; city and county officials will meet to discuss road program, which calls for paving State St., Oakdale to S. Robert Sts.; S. Robert St., St. to S. St. Paul, $140,000; White Bear Ave., from Kerwin St. to north city limits, $80,000; Stillwater rd, White Bear Ave. to east city limits, $45,000; E. Minnehaha St. Greenbrier Ave. to east city limits, $190,000; Hudson rd., Johnson Pkway. to east city limits, $78,000. Geo. J. Rice, Co. Aud.

Mo., Jefferson City—City (Paul C. Hunt, Mayor) considering resurfacing High St., Hart to Brooks Sts.; Bolivar St. to west end of viaduct; Brooks St., to Bolivar, from Chestnut to east city limits; from Walnut to Mulberry; Main St., High to W. city limits; Brooks to Bolivar Sts., and from Harrison to Bolivar Sts.; surfaced with native stone, Osage gravel or Joplin chats bound with stand. bitum. material; and Jefferson St., High to Main St.; Water St., Madison to Monroe Sts., surfaced with ver. fibre on 5-in. conc. base, bitum. filler.

Mo., Jefferson City—General Assembly passed bill providing for $60,000,000 bonds for rd. constr.; entire system will be 7,000 mi.; $31,000,000 for grav. rds. and $29,000,000 for 1,500 miles rds. conc. or higher type than gravel. A. B. Hyde, Gov.

N. Y., Brooklyn—According to report of Boro. Pres. Connolly of Queens, actual construction work will start this fall on Jamaica Bay blvd. Bd. of Est. has approved amended plans and authorized issuance of $385,000 to meet cost of grading and paving; alsot cost of two bridges which have to be built.

N. C., Lexington—Before impvt. work is completed here it is estimated about $100,000 additional will be expended on streets. Petitions in for paving Salisbury St., Center to 3rd Ave., and thence on 3rd Ave. to Main St.; 4th Ave., Main to Depot; Fifth Ave., Main to Park St.

N. C., Wentworth—Rockingham Co. sold $300,000 bonds for road construction.

N. C., Winston-Salem—State Hwy. Comn., Raleigh, plans to grade, drain and hard surface 9 miles rd. from Guilford Co. line to Waughtown, Forsyth. St. Proj. 531, C. M. Upham, St. Hwy. Engr., Raleigh.

N. D., Minot—Ward County Commrs. plan 4-year rd. program for county; 130 miles hard grav. rd. $480,000 furnished by county; $480,000 Federal aid and $24,000 by state. R. W. Kennard, Co. Aud.

Okla., Bartlesville—Washington Co. Commrs. will hardsurface entire length of highway to Bartlesville-Dewey rd. Vote Oct. 4 on $700,000 bonds.

Okla., Clinton—Bd. of Commrs. have retained Benham & Mullergreb, Cons. Engrs. Kans. City, Mo,. to design and supervise paving in business and residence districts. Approx. yardage 60,000. W. A. Shouse, city clerk.

Ore., Portland—City council considering widening of E. Couch and E. Burnside streets and Sandy boulevard and extension of the boulevard from E. 12th to E. Burnside streets to E. 16th St. It is

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
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Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
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Asphalt Floors.
The Barrett Co.
The Texas Co.
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Asphalt Machinery.
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Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies.
Lee Loader and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling and Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill & Ferguson
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
McNaughton, David.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

est. to cost abt. $200,000. Business men of east side advocating impvt.

Tenn., Chattanooga—Co. Judge S. A. Conner after conference with St. Hwy. Comm. and Fed. road officials, announces that he anticipates no difficulty in securing contract for constr. of second ten-mile section of conc. hwy. for county. The ten miles will be built on Dayton pike and Signal Mountain road.

Tenn., Knoxville—City St. Dept. contemplates pretentious repair program on Middlebrook pike, inside city limits. City has leased one of the most important rock quarries in Knox Co. for acquiring road and street bldg. material. City Comn. passed on first reading Ords. creating 13 new impvt. districts.

Tenn., Memphis—Plans under way for widening Union Ave., from downtown dist. to East St. It is proposed to make avenue 80-ft. wide entire distance, which would involve consent of all prop-owners and the expenditure of about $750,000 for paving with asph.

Tenn., Memphis—Three new impvts. being considered by city comn. Two provide for constr. of streets at est. cost of $363,206; fourth ord. passed third reading and provides for impvt. of S. Front St., at estimated cost of $83,608.

Tex., Hillsboro—Chf. Engr. U. S. Bureau Pub. Rds. Wash., D. C., approved plans for constr. of 9.9 miles 16-ft. gravel rd. on Hwy. 2-A, Hill Co., $171,536. W. L. Wya, Co. Judge; A. A. Walker, Res. Engr. also approved plans for constr of 8.7 miles 16-ft. gravel bitum. rd. on Hwy. 11, Hunt Co., $225,886. U. S. Dist. Engr., F. Worth, approved plans for constr. of 8.9 mi. 18-ft. gravel rd. on Hwy. 40, Cooke Co., at cost of $123,396. H. S. Holman, Co. Judge, Gainesville; T. E. Huffman, Co. Engr., Denton.

Tex., Houston—Mayor Holcombe will recommend to council that $100,000 in bonds, to be issued annually, be used this year for street paving work. City now has $128,000 for street work, which will make total of $228,000 available in next few months. Money will be used for street intersect. paving and necessary draing. work.

Tex., Paris—State Hwy. Dept., Austin, approved plans for constr. of 4.5 miles 16-ft. conc. road on Hwy. 5; exten. of Fed. Aid Proj. 38 now under contract. cost $164,000. W. L. Hutchinson, Co. Judge; W. M. Fooshee, Co. Engr.

Tex., Pecos—U. S. Dist. Engr., Ft. Worth, approved plans for constr. of 9.7 mi. Bankhead Hwy. to be surfaced with gravel; $64,000. J. F. Ross, Co. Judge; A. J. Adoock, Co. Engr.

Tex., San Antonio—Est. expendt. of $760,000 during coming year, according to A. McCloskey, Co. Judge. San Antonio is involved in plans for completion of 3 highways in Bexar Co., approx. 38¾ miles. One half cost will be borne by State and Fed. governments. Hwys. to be improved are: Pearsall rd., 8¾ miles, $160,000; Seguin rd., 15 miles; $300,000; Castroville rd., 15 miles, $300,000.

Tex., Waxahachie—U. S. Dist. Engr., Ft. Worth, approved plans for constr. of 4.23 miles Hwy. 14, from Ennis north to be surfaced with 16-ft. gravel; $76,300. G. G. Edwards, Co. Engr., Ennis.

Utah, Ogden—City contemplates paving Dist. 136, involving 5,000 cu. yds. excav., 15,000 sq. yds., plain conc., 8½ in. center and 6 in. sides, cost $49,500; Dist. 134, 83,560 sq. yds. 3-in. asph. on 6-in. conc. base, 3,000 cu. yds. com. earth excav., $306,511; Dist. 155, 5,800 sq. yds. 3-in. asph. on 6-in. conc. base, $16,000; Dist. 134, 30,600 lin. ft. conc. curbing and guttering. J. M. Tracy, City Engr.

Utah, Salt Lake City—State Hwy. Comn., Salt Lake City, plans to grade and gravel surface 30 miles post rd. from Levan to Scipio, 20 ft. wide, Juab Co., about $348,000. B. F. Finch, Ogden, U. S. Dist. Rd. Engr.

Va., Alexandria—$300,000 bonds will be sold for street impvts. here. E. F. Ticer, Chrmn. Finance Comn.

Va., Norfolk—Another section of Norfolk-Petersburg road is about to be constructed. State Hwy. Commr. Geo. P. Coleman has agreed to call for bids and let contract for laying conc. rd. from Courtland to Sussex Co. line, if county can complete prelim, financing. Stretch contemplated is 11¼ miles in length and will cost approx. $210,000.

SEWERAGE AND SEWAGE TREATMENT.

Ark., Warren—About 9 per cent. of the property valuation of town has been signed on petition for sewer sys. for city. Several months ago an engr. made survey and estimated cost of sewerage system for Warren at $75,000.

Ala., Birmingham—Plans and specfs. for new san. sewer relief system in business district being prepared by city engineer's dept. Jules Kendrick, city engr., reports that prelim. work will be ready within 60 days. Prelim. ests. furnished the comn. show work will cost approx. $155,000.

Cal., Oakland—Residents of northern section of city working on plan to form sanitary district. With formation of dist. sewer system will be established emptying into San Pablo Bay and furnishing sewer facilities for large sect., which cannot be accommodated in Richmond system.

Cal., Oakland—Sewers for Mills College Dist. requested by Pres. Reinhardt in letter to city council. Health of students is menaced by present conditions.

Cal., Pasadena—Resolution for constr. of sewers in Pasadena Heights territory adopted by city directors. Sewers will be laid in 12 streets, with 14-in. outfall in Allen Ave., bet. Monte Vista and Mountain, 16-in. outfall in Mountain St., bet. Allen and Sierra Bonita and 20-in. outfall in Allen Ave., bet. Villa and Monte Vista. E. P. Dewey, City Engr.

Cal., Venice—Koebig & Koebig, Cons. Engrs., Title Ins. bldg., Los Angeles, have been retained by city trustees to make survey for proposed sewage disp. system for Venice. Bond issue will be submitted as soon as prelim. plans and estimates can be prepared.

Cal., Watts—City trustees have instructed city atty. to start proceedings for constr. of complete sewer system for Watts. This action taken in response to petition from business men.

Canada, Ont., London—City Engr. H. A. Brazier announces that 6 miles storm sewers to cost $150,000 will be constructed here this fall and winter.

Canada, Ont., St. Thomas—City contemplates bldg. 11,000 ft. vitr. and concrete storm sewers in various streets. About $35,000. W. C. Miller, City Hall, Engr.

Colo., Denver—Englewood will connect its new san. storm sewer with south and west Denver san. sewer. Denver will receive $75,000 for impvt. Mr. Lowry, mgr. impvts. and pks.

Colo., Ft. Collins—Petition being circulated among prop. owners in city for extension of san. sewer sys. on W. Mountain Ave., to include blks. 1 and 2, Swett's Addn. and blks. 1 and 2, Van Slyke-Setzler Addn., from Pearl St. to center line of McKinley, thence north to center line of first alley, west to city limits, with branches running north on McKinley and Lyons Sts. to 2nd alley north of Mountain Ave., and laterals running east and west in alley.

D. C., Washington—Commrs. considering constr. of upper Potomac and main Anacostia intercepting sewers. Length of sewerage system, 753.88 miles and of sewage disp. system, 36.33 miles. Cost of sewerage and sewage disp. systems, $21,072,145.

Fla., De Land—City plans expending $600,000 for constr. of 8 miles sewerage and paving; extending and enlarging water works.

Fla., Green Cove Springs—City having surveys made for laying 2½ mi 6-8 in. sewers, manholes, etc. About $25,000. McCrary & Co., 3rd National Bk. bldg., Atlanta, Ga., Engrs.

Ill., Mt. Olive—City having plans prepared for bldg. comb. sewers (storm and san.) in various streets. About $55,000. W. Meyer, Mayor. Holbrook, Warren & Andrews, Decatur, Ill., Cons. Engrs.

Ill., Springfield—Election favorable on vote of $170,000 bond issue, which assures extension of town branch sewer.

Ind., Ft. Wayne—Co. Surv. Asa Grosvenor will call for bids for constr. of sewer system for new Int. Harvester Co. plant. Est. cost, $90,000.

Ia., Sioux City—City having plans prepared for bldg. sewers in various streets north of Morningside Ave., involving 40,700 lin. ft. 8-10 in. sewer

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.
Midwest Engine Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machine Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

pipe, 95 stand. brick manholes, etc. About $40,000. A. M. Schott, City Engr.

Ky., Paducah—City plans to install trunk line sewer; contemplates voting in November on $600,000 to $800,000 bonds.

Md., Baltimore—City (Milton J. Ruark, head of Sewerage Div. of Hwys. Dept., will construct sewerage intercepter at Locust Point to connect lat. sewers with Back River disp. plant; 27-in. pipe line from Hull to Woodall Sts., costing approx. $40,000. Mayor Wm. F. Broening, Pres. Bd. of Awards; A. E. Christhilf, Hwys. Engr.

Md., Govans Sta., Baltimore—City (Milton J. Ruark, head of Sewerage Div.) will extend $200,000 to extend sewerage system; other annex extensions planned. Mayor Wm. F. Broening, Pres. Bd. of Awards; A. E. Christhilf, Hwys. Engr.

Minn., St. Cloud—City Council petitioned to constr. sewer and water mains on Scenic Hwy, northeast from Gt. Northern trks. to city limits. W. A. Buckman, city clk.

Mo., Excelsior Springs—City has retained Cons. Engrs. Benham and Mullergren, Kans. City, Mo. to make investigations and furnish plans and specfs. for modern sewage disposal plant of Imhoff type. Bonds voted and it is planned to start constr. work as soon as possible. J. R. Lee, Mayor. W. R. Bales, city clk.

Mo., Springfield—After prelim. inspection of dist. lying south of Nichols and west of Broad Sts., Col. E. S. Finch, City Commr. of Health and Geo. W. Culler, City Engr., determined the advisability of establishing san. sewer district.

N. J., Palmyra—Palmyra Twp. receives bids in Sept. for bldg. 10 mi. 8-30 in. terra cotta san. and storm sewers in all streets. About $50,000. Remington & Vosbury, 6th & Market Sts., Engrs.

N. Y., Rochester—City soon to ask bids for bldg. sewers in Clinton Ave., Nazarre and Versailles rds., Collingwood and Rutledge drives, Argonne, Alcazar, Hargrove and St. Paul streets; also surf. sewers in street intersections, etc. About $116,800. A. R. Tuttle, City Engr.

N. Y., Spring Valley—$175,000 bonds voted here by population of less than 3,000 for installation of sewerage system.

Ohio, Columbus—Plans being prepared for san. sewerage system to connect with sewers here and to reach municipalities of Upper Arlington, Grandview and Marble Cliff, as well as considerable territory which is not in any municipality. About $185,000. R. H. Simpson, City Engr.

Tenn., Lebanon—Plans being prepared for sewerage sys. Bonds for $200,000 voted. B. H. Klyce, 712 Fourth and First Natl. Bk. bldg., Nashville, Tenn., Cons. Engr.

Tex., Houston—City contemplates constr. of storm and san. sewers. Plans to vote on $750,000 bonds.

Wis., Milwaukee—J. H. Fowler, Secy., Sewerage Comn., will receive bids in September for furnishing 6,000 tons reinforcing steel, 150,000 bbls. cement, 24 22x236 ft. rein. conc. tanks, 12 sedimentation tanks, 15 ft. deep, 98 ft. sq., crush, stone, sand, gravel, etc., for constructing aeration and sedimentation tanks on Jones Island. About $2,000,000. T. C. Hatton, City Hall, Engr.

WATER SUPPLY AND PURIFICATION.

Ala., Talladega—City (J. W. Vandiver, Mayor) contemplates expending $235,000 to install plant; daily capy. 2,000,000 to 4,000,000 gals. Install 5 miles piping, pump house, settling basin, filtr. basin reservoir. J. H. Lawson, Engr.

Cal., Fullerton—City Engr.'s office has complete plans and specfs. for water extens. under $280,000 bond issue, involving laying 85,000 ft. mains requiring 1,500 tons c. i. pipe, of which some 10,000 ft. will be 14-in. and balance smaller sizes; a 5-million gal. reinf. conc. reservoir 312x252 ft. Est. cost $62,000.

Cal., Los Angeles—State R. R. Comn. considering impvt. of water service at E. Bakersfield by completing reservoir of 750,000 gals. capy.

Ont., Grimsby—Plans prepared for water mains to cost $60,000 for No. Grimsby Twp. Council, Thos. W. Allan, Clk. Grimsby.

Que., Montreal—City Council will consider reports of Administrative Comm. recommending following work: laying water mains along Boyce St. and First Ave., Maisonneuve Ward at cost of $108,000, providing water to town of Verdun, $90,000 and laying water mains and service, $25,212.

Que., Montreal—Plans for new pumping station to be erected at ft. Atwater Ave., will soon be completed and bids will be advertised. Est. cost of constructing station, $500,000.

Ont., Toronto—Bd. of Fire Underwriters has writen Toronto Bd. of Control recommending certain impvts. in water works system, including third intake at Toronto Island, construction of another 6-ft. main from main pumping station to Front St. and installation of fire gong in main pumping station. Commr. Harris in favor of duplicating water wks. sys. by plant in the east. Comn. now making new estimate for the duplicate plant. Commr. Harris does not recommend pumping water from off Scarboro to reservoir on heights and allowing it to flow down to city mains.

Ont., York Twp.—Tp. Council intends to construct 6-in. cast iron water mains in following streets: Frater Ave., Glebemount Ave., McMichael Ave., Woodmount Ave., Monarch Pk. Ave., Poulton Ave., Holborne Ave., Page Ave., Queensdale Ave. and Walmer Rd. Total est. cost, $57,288. Engr. Frank Barber, Toronto.

Fla., Pensacola—Reed Bingham granted prelim. permit by Fed. Power Comn. for power project 55; plans consist of 5 dams and power houses with an appurtenant equipt. to generate power on Perdido River, about 8 miles so. of Muscogee; dam 13.5 ft. high; dam 13 ft. high, 1 mi. no. of Muscogee; dam 17 ft. high above Barrineau Pk; dam 255 ft. high on Styx River, abt. 1 mi. no. of Spanish Trail; dam 21.5 ft. high on Blackwater River, abt. 3 miles so. of Spanish Trail. Supervision of U. S. Geological Survey.

Md., Baltimore—City has purchased 1,200 acres in Dulaney Valley Rd. for $225,000 to provide watershed of 8,000 acres or 12 sq. mi., and storage lake with surf. of 3 sq. mi. $9,000,000 available. Wm. A. Megraw, Water Engr.

Mo., Poplar Bluff—City plans expendt. of $1,000,000 to construct settling basin and pump water from that basin to standpine.

O., Cleveland—Plans for a $3,000,000 community water works to supply Lakewood, West Park, Dover, Rocky River and other west side suburbs of Cleveland, being completed by engineers under direction of Mayor Reitz of West Park.

O., Lakewood—City plans to construct 24-in. c. i. water mains in Clifton Blvd.—Warren Rd to Highland Ave., and in Warren Rd. from Clifton to Detroit Aves. Abt. $143,000. E. A. Fischer, City Hall, Engr.

Ore., La Grande—Stevens & Koon, Cons. Engrs., Spalding Bldg., Portland, have submitted report on prelim. survey and estimates for new water supply system for city. Lower Beaver Crk. system is favored as presenting probably best adequate supply. Est. cost $500,000.

Pa., Harrisburg—State Dept. of Health, after engineering studies and investigations have approved plans for water works impvts. in Lock Haven, Greensburg, Lewistown, Charleroi, Elizabeth, Mt. Union, Coraopolis and Allen town, the latter for new pumps.

Pa., Philadelphia—City contemplates bldg. water tower; also tank 40 ft. in diam., 125 ft. high, brick, stone and slate at Belmont pumping station. Abt. $175,000. G. Brown, City Hall, Engr.

Tex., New Braunfels—Planters & Merchants Mills, S. M. Ransopher, Pres., 900 E. 40th St., Austin, will install 440-H.P. hydro-electric plant on Gaudalupe River to generate electricity for operating gingham mill to be erected at New Braunfels; mill equipt. and dam to cost $764,000.

Tex., San Antonio—San Antonio Water Supply Co., R. J. Harding, V. P. and Gen. Mgr., will expend $150,000 to erect pumping station at Mission Wells; also $600,000 next yr. to erect reservoir.

W. Va., Elkins—City—H. G. Kump, mayor—will construct 3-sty. 65x55-ft. filtr. plant, costing $45,000; two 95x65x14-ft. rein. conc. sedimentation or settling tanks, with 275,000 gals. capy. each, costing $40,000; install 2 high pressure, 2 low pressure and 1 wash water pumps with 2,000,000-gals. daily capy. each; install motors to drive pumps, total cost $9,000; expend $2,200 for intaxe, piping, sluice gate, etc.; lay mains on Lincoln Ave. and Railroad Ave. to Central, etc., costing $14,000; increase reservoir capy. from $750,000 to 1,600,000 gals., costing $7,500.

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Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
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Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

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The Texas Co.
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Littleford Brothers.

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Integrity Chemical Co.

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Good Roads Machinery Co., Inc.

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Pawling and Harnishchfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
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Good Roads Machinery Co., Inc.

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Direct Oxidation Process Corp.

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Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Rods.
Stewart, W. H.

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Coldwell-Wilcox Co.

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Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

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Integrity Chemical Co.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

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Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

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Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Littleford Brothers.

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Austin-Western Road Machinery Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
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Austin-Western Road Machinery Co.

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The Barrett Co.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

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De Laval Steam Turbine Co.

Valves.
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Cannelton Sewer Pipe Co.

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Warren Bros. Co.

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National Water Main Cleaning Co.

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U. S. Cast Iron Pipe & Foundry Co.

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Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

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The Refinite Co.

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Mueller Mfg. Co.
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American Steel & Wire Co.

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Medal Paving Brick Co.
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Murphysboro Paving Brick Co.
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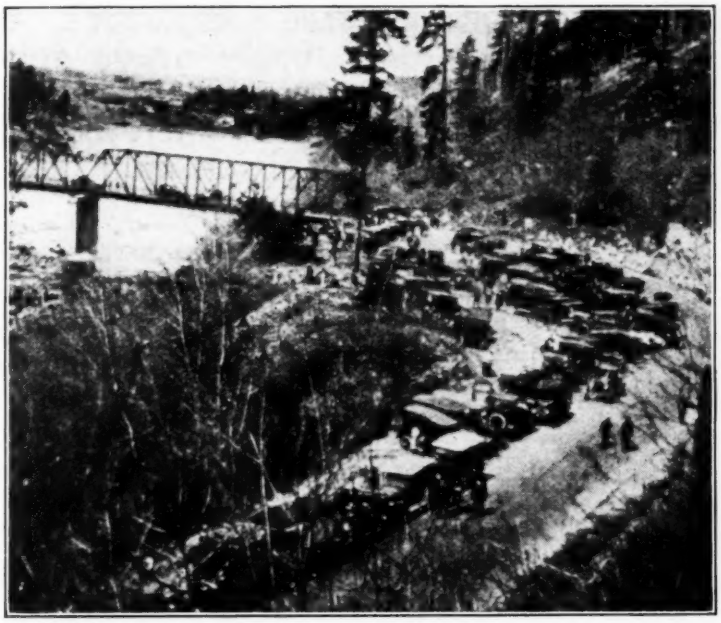

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